What is KAATSU?

Dr. Jim Stray-Gundersen, MD
Chief Medical Officer
KAATSU Global
KAATSU is:

A safe, effective, efficient method for improving specific strength in sport, leading to improved performance on the pitch.

A safe, effective, efficient method to return an injured player back to the pitch quickly.

A safe, effective, efficient method for stimulating recovery.
How does KAATSU work?

• By impeding (but not occluding) blood flow, simple easy exercises become unsustainable. This disturbance of homeostasis is transmitted to the brain, which in turn, releases an anabolic/healing neuro-humoral cascade. Since little damage was actually done, improvement in musculo-skeletal structure and function ensues rapidly.
Is KAATSU safe?

1. Approximately, 300,000 KAATSU sessions per day for years in Japan. No reports of complications.

2. National Survey
   a. 6 cases of DVT in 12,642 people undergoing ~32,000 KAATSU sessions.
      i. 1/100,000 in general population
      ii. 1/100 in hospitalized population
   b. 1 case of rhabdomyolysis in ~32,000 KAATSU sessions.
Coagulation Studies

Effects of low-intensity resistance exercise with blood flow restriction on coagulation system in healthy subjects.

Madarame H¹, Kurano M, Takano H, Iida H, Sato Y, Ohshima H, Abe T, Ishii N, Morita T, Nakajima T.


Effects of KAATSU training on haemostasis in healthy subjects


Int. J. KAATSU Training Res. 2007; 3: 11-20
Is KAATSU Efficacious?

**Fig. 4.3** Increase in muscle strength after KAATSU TRAINING on the elbow flexor muscle at 30 - 50% 1RM.

Data denote mean increase in elbow flexor muscle strength as measured by isokinetic dynamometer.

LIO; Low-intensity with occlusion (KAATSU)
HI; High-intensity conventional training
LI; Low-intensity conventional training at the same load intensity as the LIO

*P < 0.05 [Takarada Y et al., 2000]
How does KAATSU work?

• By creating an impeded (not occluded) circulation, simple exercise becomes unsustainable.

• This produces 2 local mechanisms of vascular distension/emptying and disturbance of homeostasis in exercising muscle, both which prompt up-regulation of anabolic processes like angiogenesis and muscle hypertrophy.

• These disturbances are communicated to the CNS and the CNS responds by reflex increases in heart rate and ventilation along with initiation of an anabolic neuro-humoral cascade.
If I were to clamp the femoral vein...

Femoral venous outflow would stop.

Distal venous channels and capillary beds would dilate and distend.

The femoral artery would keep pumping blood into the extremity.

Soon (5-10 seconds), the limit of the outer fascial compartments would be reached and the limb would become congested and swollen.

Arterial inflow would slow and eventually stop.
Now, if I removed the clamp...

- The femoral vein would rapidly empty, returning blood to the heart and collapsing the venous capillary vessels.
- Arterial inflow to the extremity would resume.
- The extremity would remain maximally vasodilated.
If I were to repeatedly apply the clamp for 20 seconds and then remove it for 5 seconds, we would have created an impeded, but pulsatile, venous circulation.

• That is what we do with KAATSU Cycle, only we use a narrow band of air pressure to do so.
• And the blockage of flow is incomplete and has gradations to it.
• With KAATSU bands properly applied, we create an impeded, pulsatile venous circulation with the artery pushing blood into the extremity when it can.
You use pressures of 300-400 mmHg?!

- Imagine that the pressure of the surgical clamp is infinite. No venous blood gets by it.
- Imagine that the 300mmHg of air pressure in the band is on the outside of the extremity.
- Imagine that blood (a non-compressable liquid) forces itself past the blockage and compresses air in the band.
- Imagine that the band of pressure produced in the band reduces rapidly as it goes deeper into the extremity.
- Imagine that the band pressure starts out somewhat narrower than the cuff and that width narrows as it goes deeper into the extremity.
KAATSU at 300 mmHg
13.1 ml/min

This shows the pulse of arterial blood and
One can see some retrograde flow

Here we have the patent artery and vein above it
KAATSU pressure has little to do with the athlete’s arterial blood pressure.

- KAATSU pressure is applied to the veins and moderates venous outflow.
- Moderating venous outflow eventually modifies arterial inflow.
- Blood flow into an extremity must soon match blood flow out of the extremity. However, there is some capacitance for holding extra blood in the extremity, but once that capacitance is reached, blood flow in must match blood flow out.
Mechanism and character of blood flow in an extremity with KAATSU

• When a muscle contracts, pressures in that muscle can reach high levels.
• They squeeze any blood in the muscle or vessels in the muscle, back into the major arteries and veins.
• Veins have valves, which causes blood to flow only in one direction, back to the heart.
• With KAATSU, the veins are holding lots of blood and with muscle contraction that blood is squeezed past the pressure blockage of the band.
Mechanism and character of blood flow in an extremity with KAATSU

- Sometimes, if the pressure differentials are in favor of this, when the muscle contracts, in addition to robust venous outflow, there is retrograde arterial flow.

- With KAATSU Training, and muscle contraction happening every 1-2 seconds, an impeded, pulsatile blood flow in the extremity is established.
Mechanism and character of blood flow in an extremity with KAATSU

• With KAATSU Cycle (pressure on and off with no exercise), band inflation occurring every 20-60 seconds, followed by deflation for 5-20 seconds, similarly, an impeded, pulsatile circulation is established, including an distended vasculature distal to the band, followed by an emptying of the capillaries and veins.
KAATSU versus tourniquets, elastic bands

- It has taken Dr. Sato, over 30 years to find just the right way to produce this impeded circulation in a safe, controlled and reliable way.
- This is why the KAATSU Master is necessary to produce and monitor this impaired circulation.
- Other methods and equipment are not capable of reproducibly creating these conditions.
KAATSU exercise leads to a “disturbance of homeostasis” in working muscle

• When light, easy exercises are added to this impeded circulation, the exercise quickly becomes unsustainable.
• $pO_2$, pH, drop to critical levels with even mild exercise (e.g. unweighted arm curls).
• High levels of lactate are generated.
• ATP levels drop, as ADP and $P_i$ levels rise.
• ATP dependant Electrolyte pumps (e.g. Ca$^{++}$) can not maintain proper electrolyte gradients.
Mechanism(s) of KAATSU

• **Local vascular mechanism:** There is alternating distension and emptying of the venous/capillary vascular space.

• **Local muscle mechanism:** There is “disturbance of homeostasis” in the muscle.

• These disturbances are communicated to the CNS.

• **Systemic mechanism:** The CNS reflex stimulates cardiovascular responses and releases an anabolic neuro-humoral cascade.
The CNS reacts

• There is a reflex initiation of a neuro-humoral-immuno anabolic/healing/adaptation cascade.
• All vascular tissues that have had this distension/emptying flow characteristics stimulate an angiogenic response.
• All muscular-tendon-bone units that have been exercising enjoy an anabolic growth response.
• Any current injuries are augmented/aided/accelerated by the healing, anabolic milieu.
Hemodynamic and hormonal responses to a short-term, low intensity, resistance exercise with the reduction of muscle blood flow

Haruhito Takano · Toshihiro Morita · Haruko Iida
Ken-ichi Asada · Masayoshi Kato · Kansei Uno
Ken Hirose · Akihiro Matsumoto · Katsu Takenaka
Yasunobu Hirata · Fumio Eto · Ryozo Nagai
Yoshiaki Sato · Toshiaki Nakajima

Todd Lodwick
37 y/o, 6-time Nordic Combined Olympian

- January 10th 2014 Fell ski jumping, multiple comminuted fracture of L humerus, labral tear, disrupted rotator cuff, broken rib.
- Challenge: maintain fitness and heal L shoulder sufficiently to meaningfully compete in 2014 Sochi Olympic Games (Opening Ceremonies February 7th).
- On January 13th, initiated normal KAATSU Training on 3 uninjured extremities and modified KAATSU Cycle and Training on L arm, 2X/day.
- In addition to KAATSU, uphill treadmill walking, rollerskiing with one pole, stationary cycling.
Todd’s Injury 1/10/14
USA Flag bearer

Note: carrying flag in Left hand 4 weeks post injury
Olympic Team Event 40 days post injury
Todd Lodwick
37 y/o, 6 time Nordic Combined Olympian

- Jan 28th, first run down landing hill; first cross country skiing.
- Feb 7th, carried US flag in Opening Ceremonies
- Feb 10th, first ski jumping practice, normal hill
- Feb 13th, first XC interval session
- Feb 20th, Olympic NC Team competition (40 days post injury).
  - Normal, expected jumping performance
  - 95% typical performance in 5 km XC skiing (12:28)
  - Team finished respectable 6th place.
Bode Miller
36 y/o Olympic and World Champion Alpine Racer

- Bronze medal Super G, Sochi Olympic Games Feb 2014
- Chronic back and knee pain preventing normal training in the summer and fall of 2014.
- Oct. -> Introduction to KAATSU Training
- Dec. -> Micro disectomy L4-L5
- Post Op: KAATSU Training twice per day.
- In late Dec/Jan, some easy alpine skiing plus a few training runs on race courses.
- Feb 9th Super G Competition, Vail World Championships.
- Result: crash and DNF. However, skiing really well and leading the race at the time, likely medal performance, possibly gold. Two severe lacerations to back of knee and gastrocnemius preventing further competition.
Bode Miller
Olympic and World Champion Alpine Racer
Bode, Super G, Vail 2015
2 months post op microdisectomy
Bode, Super G, Vail 2015
lacerated semi-tendinosis
Josh Saunders
32 y/o Keeper for LA Galaxy, Real Salt Lake and NYCFC

• July 13 2013: Tore L ACL during a match
• July 23, 2013: L ACL reconstruction using L hamstring graft.
• Aug 3, 4, 7th ‘13 Graft/joint/bone infection requiring multiple re-operation, graft removal, debridement and long term antibiotic treatment.
• Due to disuse, infection and multiple surgical procedures, quadriceps and associated musculature were markedly atrophied.
• Sept 13, ‘13 Started Alter-G and KAATSU training daily.
• Oct 15, ’13 Re-operated, bone graft used for sealing previous canals.
Josh Saunders
Keeper for LA Galaxy, Real Salt Lake and NYCFC

• Jan 6th, ‘14 L ACL reconstruction with R hamstring graft.
• Alter-G and KAATSU protocols re-started within first post-op week.
• 12 weeks post-op; gait, girth and strength of quadriceps normal and symmetric to contralateral side. Instituted drills on the pitch.
• 18-24 weeks. Return to normal training/practice.
• First game, 23 weeks post op.
• March ’15 MLS player of the month
Josh 8 weeks post L ACL repair
Equal quad girths
Josh Saunders keeping goal
Josh Saunders, 100% rehabilitated 1 year post L ACL repair
Conclusion of Case Reports

• In all 3 cases, KAATSU Cycle and Training were the primary and critical rehabilitation tool in returning these elite athletes to their sport.
• In all 3 cases, the athletes were competing much earlier than expected.
• In all 3 cases, the whole athlete was re-conditioned for the demands of their sport, with minimal loss of fitness.
Conclusions

• KAATSU is safe, when proper equipment is used and Dr. Sato’s protocols are properly applied.

• KAATSU is efficacious at:
  – Building strength with short workouts (30 minutes) and in as few as 10 sessions.
  – Improving performance where specific strength is a critical parameter

• KAATSU accelerates return to sport.
Conclusions

• KAATSU simply tricks the brain into thinking a huge, horrendous workout has occurred and it must repair the damage, where in reality, little damage has been done and rebuilding just makes structure and function better rapidly.

• KAATSU allows significant maximal intensity training while injured joints, bones, and muscles heal expeditiously.
When KAATSU is used with Dr. Sato’s equipment and protocols

A safe, effective, efficient method for improving specific strength in sport, leading to improved performance on the pitch.

A safe, effective, efficient method to return an injured player back to the pitch quickly.

A safe, effective, efficient method for stimulating recovery.