2015 KAATSU International Symposium
Harvard Medical School
November 5 – 6
## 2015 KAATSU International Symposium Agenda

<table>
<thead>
<tr>
<th>Welcome:</th>
<th>Peter Lansbury, Ph.D., Professor of Neurology, Harvard Medical School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening Speech</td>
<td>Professor Sir Yoshiaki Sato, Ph.D., M.D., FNAI, Inventor of KAATSU Training and Founder of KAATSU Japan and KAATSU International University (Sri Lanka)</td>
</tr>
<tr>
<td>Keynote Speech</td>
<td>James Stray-Gundersen, M.D., Chief Medical Officer, KAATSU Global and Sports Science Director, U.S. Ski &amp; Snowboard Association</td>
</tr>
<tr>
<td>Guest Lecture</td>
<td>Toshiaki Nakajima, M.D., Ph.D., Heart Center, Dokkyo Medical University</td>
</tr>
<tr>
<td>Presentation 1</td>
<td>Peter Lansbury, Ph.D., Professor of Neurology, Harvard Medical School</td>
</tr>
<tr>
<td>Presentation 2</td>
<td>Robert Heiduk, Sports Scientist, Universität Bonn</td>
</tr>
<tr>
<td>Presentation 3</td>
<td>John Murray, formerly of Stanford University and Golden State Warriors and Murray Athletic Development</td>
</tr>
<tr>
<td>Presentation 4</td>
<td>Chris Morgan, Olympic Swim Coach, formerly of Stanford &amp; Harvard</td>
</tr>
<tr>
<td>Presentation 5</td>
<td>Paul Grzymkowski, former president of Gold’s Gym International</td>
</tr>
<tr>
<td>Presentation 6</td>
<td>Dr. Michael Kessler, D.C., C.C.S.P.</td>
</tr>
<tr>
<td>Presentation 7</td>
<td>Lyle Nalli, DPM, Davita HealthCare Partners</td>
</tr>
<tr>
<td>KAATSU Specialist Training</td>
<td>KAATSU Specialist Training by Drs. Yoshiaki Sato and James Stray-Gundersen</td>
</tr>
<tr>
<td>Panel 1</td>
<td>Panel Discussion on KAATSU In Sports</td>
</tr>
<tr>
<td>Panel 2</td>
<td>Panel Discussion on KAATSU In Medicine</td>
</tr>
<tr>
<td>Panel 3</td>
<td>Panel Discussion on KAATSU In Therapy</td>
</tr>
</tbody>
</table>
Joseph B Martin Conference Center
Harvard Medical School
Boston, Massachusetts
Professor Sir Yoshiaki Sato, M.D., Ph.D., FNAI
Inventor of KAATSU Training
Founder of KAATSU Japan Co., Ltd.
Chairman, KAATSU Global, Inc.
Chancellor, KAATSU International University (Sri Lanka)
What is KAATSU?
The concept of KAATSU was inspired 49 years ago while sitting on my feet.

加圧トレーニングとは？

加圧トレーニングが誕生の歴史は今から約49年前に始まった

加圧トレーニング誕生

1966年 法事での正座による「脚の痺れと腫れ」
加圧トレーニングのアイデアの原点となる

日本古来の習慣— 正座
KAATSU began in 1966 and it took another 17 years of experimentation to develop KAATSU principles and practical know-how.
1973年 スキーツアーで大怪我（両踝骨折、半月板・内側側副靭帯損傷）
全治6ヶ月の即手術・入院要の診断

KAATSU rehabilitation began in 1973 when I badly injured myself and used the principle of KAATSU Cycle to help fully recover within 6 weeks

3月11日
スキーツアー、先頭を得意げに滑走するがこのあと悲劇が！

5月5日
驚異の回復でくらやみ祭りのお神輿を担ぐ

自らの加圧トレーニング法によるリハビリで1.5ヶ月で奇跡の回復
4月末のレントゲン結果で、両踝が奇跡的に骨癒合されていた。
Dr Sato participated in a Japanese festival with a 1,400-year history soon after rehabilitating himself with KAATSU.
リハビリリとしての効果を確信

1973年 スキーで骨折後、加圧トレーニングで早期回復（骨癒合の効果、靭帯・腱・半月板等の早期回復、筋力・筋肉の増大等の効果を確信）

この間10年間、ジムの会員に対して加圧トレーニングを実施（延べ数万人）

1983年 他人に対する加圧トレーニング法のノウハウを蓄積し、構築した。

After recovering from his broken bone with KAATSU, Dr. Sato applied KAATSU to several tens of thousands of patients over the next 10 years.
It can be said that Dr. Sato was born doing KAATSU – he was born with the umbilical cord wrapped around his neck. He was judged to be a feeble child – missing 1/3 of his school year at the age of 7.
At the age of 67, Dr. Sato is the epitome of healthful living after first proving KAATSU on himself. KAATSU is a form of preventive medicine, says the WHO chairman.
Thank you very much for your kind attention.
Keynote Speech
James Stray-Gundersen, M.D., Chief Medical Officer, KAATSU Global Sports Science Director, U.S. Ski & Snowboard Association
Vascular, Muscular and Autonomic Changes in Response to KAATSU

Dr. Jim Stray-Gundersen, MD
Chief Medical Officer
KAATSU Global
I have been reading, learning and practicing KAATSU Training in the USA for ~15 months.
Dr. Sato has developed a very special form of training.

Josh Saunders
New York City Football Club

Mikaela Shiffrin
Slalom Gold
Sochi

Ted Ligety
Giant Slalom Gold
Sochi

Future Kentucky Derby Winner
My Findings

• KAATSU is very safe, when done Dr. Sato’s way.
• KAATSU is very effective at improving strength and fitness, when done Dr. Sato’s way.
• KAATSU is very convenient and time efficient, when Dr. Sato’s way.
• KAATSU is difficult to explain
• How do you do KAATSU safely and effectively?
• How do you educate excellent KAATSU Instructors?
• U.S. military, coaches, and corporations need scientifically sound, accurate explanation.
My Questions

• Are researchers who study ischemic or blood flow restriction training, doing KAATSU?

• Are researchers who think they are doing KAATSU, doing it correctly?

• What is the correct way to describe KAATSU?

• What is the best way to show safe and effective KAATSU?
Tools to Explain KAATSU

• **Doppler Ultrasound** to document the arterial and venous blood flow changes.

• **Near Infra Red Spectroscopy** to document the profound disturbance of homeostasis in the exercising muscle from proper KAATSU.

• **Heart rate monitoring** to document the changes in autonomic function from KAATSU Training.

• **High Pressure Liquid Chromotography** to document changes in the Metabolome to KAATSU Training.
Monitoring Setup

- **First Beat Body Guard**
  - Heart Rate Monitor
  - Accellerometer

- **MOXY**
  - Near Infra Red Spectroscopy
  - SmO₂
  - Muscle Oxygen Saturation

- **Sonosite MicroMaxx**
  - Doppler Ultrasound
  - Arterial and Venous blood flow

- **Nelcor**
  - Pulse Oximeter
  - SpO₂
  - Arterial Oxygen Saturation
KAATSU at 48 mmHg (fitting pressure)
56.7 mls/min

This shows the pulse of arterial blood
KAATSU at 100 mmHg
21.8 mls/min

This shows the pulse of arterial blood
KAATSU at 200 mmHg
20.8 mls/min

This shows the pulse of arterial blood

Here we have the patent artery and vein above it
KAATSU at 300 mmHg
13.1 mls/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.
With Doppler Ultrasound, we can prove that we:

– Impede, but do not occlude arterial inflow.
– Vasodilate all blood vessels distal to the KAATSU air band.
– Impede and distend the capillary and venous space.
– Change the venous outflow pattern to pulsatile flow in the deep, major veins when the muscle contracts.
Vascular Mechanics of KAATSU

• When the KAATSU band is applied, the venous and capillary space distend.
• Once they have maximally distended, any additional arterial inflow is accompanied by venous outflow. However, this is done when the muscle contracts.
• The effect is one in which the circulation is impeded or slowed such that working muscle does not get the oxygen and fuel it needs to continue to work.
• In addition, metabolic waste products are not cleared, causing disturbance of homeostasis in the working muscle.
Disturbance of Homeostasis in Muscle

**Protocol**

Relaxed Rest
Fitting Pressure (50 mmHg)
25 arm curls
KAATSU 100 mmHg
25 arm curls
Release
KAATSU 200 mmHg
25 arm curls
Release
KAATSU 300 mmHg
25 arm curls
Release
KAATSU 400 mmHg
Arm curls to failure
Release
Muscle proximal (blood flow not limited) to the air band
Not very active in arm curls

No KAATSU
No Exercise

**MOXY**
- Total Hb in muscle
- SmO2

Proximal to cuff—R Deltoid
(not exercising, no KAATSU)

Distal to cuff—R Biceps
(Exercising, KAATSU)

Cuff at Fitting Pressure—L Biceps
(Exercising, but no KAATSU)
Total [Hb] (gms/dl) R deltoid

No blood flow impediment
No exercise
<table>
<thead>
<tr>
<th>KAATSU</th>
<th>0 mmHg, 25 Arm curls</th>
<th>50 25 a.c.</th>
<th>100 25 a.c.</th>
<th>200 25 a.c.</th>
<th>300 25 a.c.</th>
<th>400 25 a.c.</th>
<th>Recovery: Arm curls to fail</th>
</tr>
</thead>
</table>

No blood flow impediment
No exercise
Air band not inflated  
(blood flow not limited)  
Same exercise as right arm  

No KAATSU  
Exercise  

**MOXY**  
- Total Hb in muscle  
- SmO2  

Proximal to cuff— R Deltoid  
(not exercising, no KAATSU)  

Distal to cuff— R Biceps  
(Exercising, KAATSU)  

Cuff at Fitting Pressure— L Biceps  
(Exercising, but no KAATSU)
Total [Hb] (gms/dl) L biceps

No KAATSU Arm Curl Exercise (like the right side)
Left m. Biceps SmO$_2$ (%)

No KAATSU, Arm curl exercises

- Rest
- 25 arm curls
- 25 arm curls
- 25 arm curls
- 25 arm curls
- 25 arm curls
- Arm curls to failure on right arm

Recovery Hyperemia
Muscle distal (blood flow limited) to the air band. Very active in arm curls

**KAATSU Exercise**

**MOXY**
- Total Hb in muscle
- SmO2

Proximal to cuff—R Deltoid
(not exercising, no KAATSU)

Distal to cuff—R Biceps
(Exercising, KAATSU)

Cuff at Fitting Pressure—L Biceps
(Exercising, but no KAATSU)
Total [Hb] (gms/dl) R biceps

KAATSU--blood flow impediment
Exercise to failure
Right m. Biceps SmO$_2$ (%)
SmO₂ of the time during Arm Curls to Failure at 400 mmHg

Very quickly, these contractions were associated with pain in the active muscle and eventually (~50 reps) led to contraction failure.

Air Band at 400 mmHg
Contractions start
Muscle “burn”
Muscle Failure
Contractions end
Air Band released
Correct KAATSU

• Profound Desaturation in Exercising Muscle
  – Hemoglobin in the working muscle 0-15% saturated with Oxygen
• Profound Reactive Hyperemia post Exercise
• Unable to continue (Muscle Failure)
First Beat Body Guard
Autonomic Function
Heart Rate Variability
Heart Rate
Ventilation
Energy Expenditure
No Bands

Arm Curls: 25-25-25
Hand Grip: 25-25-25
Push Ups: 25-25-25
Double Leg Squats: 25-25-25
Heel/Toe: 25-25-25
R & L Single Leg Squats: 25-25-25

“REAL” KAATSU

410 mmHg arms bands
Arm Curls: 50-30-20
Hand Grip: 50-40-30
Push Ups: 50-30-10

460 mmHg leg bands
Double Leg Squats: 50-30-25
Heel/Toe: 25-25-25
R & L Single Leg Squats: 30-25-20
All exercises to muscle failure

“Inadequate” KAATSU

100 mmHg

Arm Curls: 25-25-25
Hand Grip: 25-25-25
Push Ups: 25-25-25

Double Leg Squats: 25-25-25
Heel/Toe: 25-25-25
R & L Single Leg Squats: 25-25-25
Sympathetic Activation

Real KAATSU
Arms 410 mmHg
Legs 460 mmHg
All exercises to failure

Inadequate KAATSU
Arms 100 mmHg
Legs 100 mmHg
No exercise to failure

No KAATSU
Just exercises
Heart Rate (bpm)

Real KAATSU
Arms 410 mmHg
Legs 460 mmHg
All exercises to failure

Inadequate KAATSU
Arms 100 mmHg
Legs 100 mmHg
No exercise to failure

No KAATSU
Just exercises
VenGlaGon

Ventilation
L/min

Real KAATSU
Arms 410 mmHg
Legs 460 mmHg
All exercises to failure

Inadequate KAATSU
Arms 100 mmHg
Legs 100 mmHg
No exercise to failure

No KAATSU
Just exercises
Energy Expenditure (Kcals/min)

Real KAATSU
Arms 410 mmHg
Legs 460 mmHg
All exercises to failure

Inadequate KAATSU
Arms 100 mmHg
Legs 100 mmHg
No exercise to failure

No KAATSU
Just exercises
KAATSU: Training Effect Score 1.6

Endurance Training Classification

Classification of the measurement to different endurance training types.

Sham KAATSU: Training Effect Score 1.8

Endurance Training Classification

Classification of the measurement to different endurance training types.
• Incorrect KAATSU is similar to exercise without KAATSU.
• Correct KAATSU has a much greater sympathetic activation than either incorrect KAATSU or exercise without KAATSU.
• Correct KAATSU has a greater increase in heart rate and ventilation than incorrect KAATSU or exercise without KAATSU.
• Correct KAATSU has higher energy expenditure than incorrect KAATSU or exercise without KAATSU.
• Correct KAATSU stimulates a robust autonomic response.
Current day laboratory assessment of metabolic status

$50 -- $100 per assessment
Dr. Robert Gerzsten
Harvard Medical School,
Massachusetts General Hospital
Where to mine for novel pathways and predictors

- nucleotides
- amino acids
- organic acids
- carbohydrates
- lipids

--from Wang & Gerszten *Nature* 2008
Requires only a drop of blood (100μl)
Targeted Metabolomics Platform

Organic acids, amino acids, nucleotides, carbohydrates, lipids

Metabolite “Address”:
Chromatographic elution time, mass spec characterization
Platform Coverage

Targeted approach covering major pathways downstream of protein, lipid and carbohydrate metabolism
- Reproducibility: CVs (~10-15%)
- Sensitivity: low ng/ml
- Breadth:
  - ~400 endogenous metabolites
  - ~30 “exogenous” metabolites (drugs)
- Sample volume: ~50 µl
- Throughput: ~50 samples per day (30 min LC runs)
- Cost: ~1 dollar per analyte
From a drop of blood (100ul), Dr. Gerzsten is able to measure the change in over 400 metabolites.

This will allow us the opportunity to follow the changes in metabolism from correct and incorrect KAATSU and follow the changes from a series of proper KAATSU sessions.
Summary

We are utilizing scientific tools to:
1. document the physiologic changes with KAATSU Training performed correctly.
2. Distinguish between correct and incorrect KAATSU
   1. In scientific studies
   2. In teaching new instructors
3. Future studies will need to utilize these methods to prove they are doing KAATSU properly.
Summary

Dr. Sato has developed a technique (KAATSU) that will change how the world trains and rehabilitates.

And we will be able to document those beneficial effects, as well as, be able to teach the correct KAATSU training.
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.
Effects of low-intensity resistance exercise with blood flow restriction on coagulation system in healthy subjects.

Madarame H, 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?

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]

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

• pO₂, 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 Pᵢ 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 3\textsuperscript{rd} 2014 won National Championship, qualifying for 6\textsuperscript{th} Olympic Games.

• January 10\textsuperscript{th} 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 7\textsuperscript{th}).

• On January 13\textsuperscript{th}, 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
- 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 contra-lateral 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, KAATTSU 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 expediously.
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.
Guest Lecture
Toshiaki Nakajima, M.D., Ph.D.
Heart Center, Dokkyo Medical University Hospital
Skeletal Muscle Hypertrophy Induced by Novel KAATSU Rehabilitation and Prevention of Sarcopenia

Toshiaki Nakajima, M.D. ph.D.

Dokkyou Medical University, Japan
Sarcopenia, the loss of muscle mass, is an important problem in the older population.

Muscle strength is decreased with age. Muscle volume is quickly decreased 0.45 Kg/year at ages >50 years old. (1%/day in space, 0.6%/day bed rest). Especially, fast twitch fiber decreased to 50% by 80 years old.

To prevent it, high-intensity resistance exercise is usually required, but it cannot be performed in the elderly people. In this symposium, I present our recent data of KAATSU training in elderly persons and basic researches using rat KAATSU model.
Conditions necessary for muscle hypertrophy

(American Sports of Medicine, 2000)

Strength: 70～80% 1RM (8～15RM)  
(lower than 65%: unreliable effects)

Number: until exhaustion

Sets: 3 sets

Frequency: 2～3 times/week

It is impossible to apply such a high-intensity exercise for older subjects or patients.
KAATSU training

The KAATSU training developed by Dr. Sato is a unique technique of performing low-load exercise with restricted muscle blood flow, by using a specially designed KAATSU belt.

It can induce muscle hypertrophy and strengthen muscle even by using a short-term and low-intensity exercise as equal as high-intensity exercise.

**Muscle stimuli**

Muscle hypertrophy and strength

70-80 % 1 RM
Thus, it is likely that KAATSU training mobilizes many muscle fibers including fast fibers.
【Research 1】 Effects of KAATSU training in elderly subjects

【Subjects】Healthy elderly subjects 19 cases
(Mean age 71 years old)
→KAATSU group (9 cases), control group (10 cases)

【Exercise】Knee Extension & Leg Press

【KAATSU pressure】120 ~ 250 SKU

【Period】12 weeks (2 times/week)

84 years old

Knee Extension
(~20% 1RM)

Leg Press
(~30% 1RM)
A typical example of the effects of KAATSU training on cross sectional area of thigh 50% position (MRI)

Case: YN (70 years old)

Pre training

3 months after training

Effects of KAATSU training on muscle size (Thigh 50% position)

**Quadriceps**

- **KAATSU**: 8.0 cm²
- **Control**: P<0.01

**Adductor**

- **KAATSU**: 6.5 cm²
- **Control**: P<0.05

**Chair Stand**

- **KAATSU**: 18%
- **Control**: 3%

Increasing muscle strength and muscle mass can improve life function test measured by chair stand test.
Similar results were observed in upper limbs using an elastic band in elderly subjects

YN (71 year old)

Biceps

Triceps

The process leading up to muscle hypertrophy from resistance training

Resistance training

- Initial stimulus factors
  1) Mechanical stress
  2) Metabolic stress
  3) Hormone (catecholamine)
  4) Growth factor (GH), Cytokine (IL-6)
  5) Nerve factor
  6) Local circulation
  7) Local oxygen environment (hypoxia)
  8) Cell swelling, stretch et al.

Need 1RM > 65% to induce hypertrophy

Adaptation
1) Protein synthesis↑
2) Protein degradation↓

Mechanisms of the hypertrophic effects of KAATSU training?
Several mechanisms underlying hypertrophic effects of KAATSU training

① Increase of muscle activity → Recruitment of fast fibers with a high degree of training effect
② Growth hormone secretion GH/IGF-1 ↑ → Amino acid uptake, protein synthesis ↑
③ Protein synthesis speed ↑ → Muscle hypertrophy
④ Recruitment of muscle satellite cells?
⑤ Decrease in myostatin → muscle hypertrophy

Maintenance of skeletal muscle mass is dependent on the relationship of muscle protein balance (protein synthesis and breakdown). A negative protein balance induces muscle atrophy, whereas a positive balance induces muscle hypertrophy.

After muscle disuse, during long-term bed rest, spaceflight and simulated models of no-bearing activity, severe skeletal muscle atrophy develops due to the altered protein metabolism leading to decreased muscle contractile protein content.

To prevent it, resistance exercise, an established and potent stimulus for enhancing muscle protein synthesis and subsequent muscle hypertrophy, is usually used.
On the other hand, skeletal muscle is a plastic organ that adapts its mass to the different conditions by affecting pathways that regulate protein and cellular turnover.

Takarada et al. (2000): **Repetitive application of KAATSU** (repetitive KAATSU) diminished the post-operation disuse atrophy of knee extensors in patients who underwent an operation for the reconstruction of the anterior cruciate ligament.

From the paper, repetitive KAATSU appears to be a novel stimulus for skeletal muscle to induce a net positive protein balance and prevent atrophy. However, the underlying mechanism of repetitive KAATSU has not been investigated.
Therefore, we investigated the effects of repetitive KAATSU on muscle O₂ partial pressure (PmO₂), mammalian target of rapamycin (mTOR) signaling pathways involved in translation initiation of skeletal muscle in rat KAATSU model.

(presented at 2013 AHA meeting, Nakajima T et al., submitted)
Methods:
Wistar rats (10 weeks, male) underwent repetitive KAATSU under isoflurane anesthesia.

Repetitive KAATSU
- Repetitive KAATSU to the right lower extremity was induced by compressing the proximal end of the right thigh with a Durable Digit Cuff.
- Repetitive KAATSU stimulus, which consisted of an external compressive force of 100 mmHg for 5 min, followed by 3 min of rest, was repeated six times during a 48-minute interval.

Muscle oxygen partial pressure:
- Measurement of PmO2: Phosphorescence quenching
- Muscle sampling (protein, total RNA)
- Real-time RT-PCR
- Western blotting
Effects of repetitive KAATSU on muscle pO2 (PmvO2) (Aa, b), total muscle weight (Ba) and total muscle weight/body weight (Bb).

Aa

Effects of repetitive KAATSU on muscle pO2 (PmvO2)

- KAATSU
- 5min 5min 5min 5min 5min 5min

PO2 (Torr)

- 0 10 20 30 40 50

Time

- Rest 1st 2nd 3rd 4th 5th 6th

KAATSU

Bb

Total muscle weight of the tibialis anterior muscle (Ba) and total muscle weight/body weight (Bb)

- Left KAATSU (-)
- Right KAATSU (+)

Total muscle weight mg

- Pre 480 480 480 480 480
- Post 0h 430 430 430 430 430
- 1h 430 430 430 430 430
- 3h 430 430 430 430 430
- 6h 430 430 430 430 430

Total muscle weight/body weight

- Pre 1.80 1.80 1.80 1.80 1.80
- Post 0h 2.00 2.00 2.00 2.00 2.00
- 1h 1.80 1.80 1.80 1.80 1.80
- 3h 1.80 1.80 1.80 1.80 1.80
- 6h 1.80 1.80 1.80 1.80 1.80

* indicates significant difference.
Improvement of cognitive function

KAATSU training in a patient with dementia
Conclusion

KAATSU rehabilitation may be a novel useful method to promote muscle strength and hypertrophy safely in patients with elderly subjects, patients, and astronauts.

Space flight

Patients with orthopedic diseases

Disuse syndrome, sarcopenia, cachexia

KAATSU training

Various diseases including cardiovascular diseases
Collaborators

Tokyo University
  Yasuda T, Iida H, Kurano M, Takano H, Morita T, Fukumura K,
  Nagai R, Yamasoba T

KAATSU International University
  Sato Y

Dentsu University
  Koide S, Kano Y

Thank you very much for your attention.
Presentation 1
Peter Lansbury, Ph.D.
Professor of Neurology, Harvard Medical School
Center for KAATSU Research at Harvard Medical School

Yoshiaki Sato
Founder and Chairman

Peter Lansbury, Professor of Neurology
Parkinson’s disease
Parkinson’s Disease: Symptoms and Progression

• First described by James Parkinson in Hyde Park in mid 19th century

• Muhammad Ali, Michael J Fox, Robin Williams

• Prevalence is ca 1/100 at age 60, 2/100 at age 80

• Diagnosis requires 2 of 3 cardinal features:
  • Bradykinesia/muscle weakness
  • Muscle stiffness
  • Tremor

• Progression is slow but relentless

• Prodromal phase is characterized by autonomic dysfunction

• Cost of the debilitating stage of disease is enormous…. who bears that cost?
Parkinson’s Disease: Treatments are transiently effective and do not slow progression

- Movement issues are primarily due to loss of dopamine-producing neurons in the brain.

- Most effective treatments are designed to replenish dopamine levels:
  - L-DOPA (Sinemet)
  - Dopamine agonists (Mirapex)

  Some studies in mice show increased brain dopamine release in response to exercise. In humans, placebo can induce DA release.

- Dopamine replacement is only effective for 5-7 years, so neurologists typically do not start until symptoms are quite bad.
Parkinson’s disease onset is typically late in life and motor symptoms are progressive.
Changing the rate of disease progression could drastically reduce the prevalence of debilitating PD.
Can KAATSU be used for the Treatment of Parkinson’s Disease?

Like IA, these patients are generally weak and unable to get a conventional high-intensity weight training workout, although weight training is known to be effective.

Unlike IA, PD is a brain disease; how does KAATSU effect the brain?
Energy Metabolism during Repeated Sets of Leg Press Exercise Leading to Failure or Not

Esteban M. Gorostiaga1*, Ion Navarro-Amézqueta1, José A. L. Calbet2, Ylva Hellsten3, Roser Cusso4, Mario Guerrero4, Cristina Granados1, Miriam González-Izal1, Javier Ibañez1, Mikel Izquierdo1

1Studies Research and Sports Medicine Centre, Government of Navarre Pamplona, Spain, 2Department of Physical Education, University of Las Palmas de Gran Canaria, Las Palmas de Gran Canaria, Spain, 3Molecular Physiology Group, Section of Human Physiology, Department of Exercise and Sport Sciences, Copenhagen Muscle Research Center, University of Copenhagen, Copenhagen, Denmark, 4Department of Physiological Sciences, IDIIBAPS, University of Barcelona, Barcelona, Spain

![Graph showing the relationship between peak power and muscle lactate concentration.]

R² = 0.64, p < 0.001

Figure 4. Individual relationships between the relative average peak power output changes (expressed in percent of initial value) between the first and the last two repetitions of the first set and between the first and last two repetitions of the exercise, and muscle lactate concentrations, during 10REP (open circles), and 5REP (filled circles).
Increased muscle hypertrophy increases function in PD patients

*High-intensity resistance training amplifies muscle hypertrophy and functional gains in persons with Parkinson’s disease.*

Dibble LE¹, Hale TF, Marcus RL, Droge J, Gerber JP, LaStayo PC.

**Abstract**

Strength deficits in persons with Parkinson’s disease (PD) have been identified as a contributor to bradykinesia. However, there is little research that examines the effect of resistance training on muscle size, muscle force production, and mobility in persons with PD. The purpose of this exploratory study was to examine, in persons with PD, the changes in quadriceps muscle volume, muscle force production, and mobility as a result of a 12-week high-force eccentric resistance training program and to compare the effects to a standard-care control. Nineteen individuals with idiopathic PD were recruited and consented to participate. Matched assignment for age and disease severity resulted in 10 participants in the eccentric group and 9 participants in the control group. All participants were tested prior to and following a 12-week intervention period with testing and training conducted at standardized times in their medication cycle. The eccentric group performed high-force quadriceps contractions on an eccentric ergometer 3 days a week for 12 weeks. The standard-care group exercise program encompassed standard exercise management of PD. The outcome variables were quadriceps muscle volume, muscle force, and mobility measures (6-minute walk, stair ascent/descent time). Each outcome variable was tested using separate one-way analyses of covariance on the difference scores. Muscle volume, muscle force, and functional status improvements occurred in persons with PD as a result of high-force eccentric resistance training. The eccentric group demonstrated significantly greater difference scores for muscle structure, stair descent, and 6-minute walk (P < 0.05). Magnitude of effect size estimators for the eccentric group consistently exceeded those in the standard-care group for all variables. To our knowledge, this is the first clinical trial to investigate and demonstrate the effects of eccentric resistance training on muscle hypertrophy, strength, and mobility in persons with PD. Additional research is needed to determine the anatomical and neurological mechanisms of the observed strength gains and mobility improvements.

(c) 2006 Movement Disorder Society.
Novel, high-intensity exercise prescription improves muscle mass, mitochondrial function, and physical capacity in individuals with Parkinson’s disease


1UAB Center for Exercise Medicine, University of Alabama at Birmingham, Birmingham, Alabama; 2Department of Cell, Developmental, and Integrative Biology, University of Alabama at Birmingham, Birmingham, Alabama; 3Department of Physical Therapy, University of Alabama at Birmingham, Birmingham, Alabama; 4Department of Neurology, University of Alabama at Birmingham, Birmingham, Alabama; 5Department of Nutrition Sciences, University of Alabama at Birmingham, Birmingham, Alabama; 6Department of Surgery, University of Alabama at Birmingham, Birmingham, Alabama; and 7Geriatric Research, Education, and Clinical Center, Birmingham VA Medical Center, Birmingham, Alabama

Submitted 21 November 2013; accepted in final form 8 January 2014

Kelly NA, Ford MP, Standaert DG, Watts RL, Bickel CS, Moelling DR, Tuggle SC, Williams JY, Lieb L, Windham ST, Bamman MM. Novel, high-intensity exercise prescription improves muscle mass, mitochondrial function, and physical capacity in individuals with Parkinson’s disease. J Appl Physiol 116: 582–592, 2014. First published January 9, 2014; doi:10.1152/japplphysiol.01277.2013.—We conducted, in persons with Parkinson’s disease (PD), a thorough assessment of neuromotor function and performance in conjunction with phenotypic analyses of skeletal muscle tissue, and further tested the adaptability of PD muscle to high-intensity exercise training. Fifteen participants with PD (Hoehn and Yahr stage 2–3) completed 16 wk of high-intensity exercise training designed to simultaneously challenge strength, power, endurance, balance, and mobility function. Skeletal muscle adaptations (P < 0.05) to exercise training in PD (tremor, postural instability, rigidity), which dramatically impacts mobility function and life quality. Weakness, low muscle power, and fatigability are common findings in PD (28, 73). In fact, many with the disease suffer disabling, dopa-resistant fatigue (39), and those with severe fatigue are more sedentary and have lower functional capacity (31). Because risk increases with age (96% diagnosed >age 50), PD progresses concurrent with the obligatory losses of muscle mass and function consequent to aging that likely compound the deleterious effects of the primary disease. In apparently healthy older adults, we (43, 57) and others (15, 61) have documented aging-related muscle atrophy, weakness, low muscle power, and fatigability and have demonstrated robust improvements in
Increased lactate/pyruvate ratio augments blood flow in physiologically activated human brain

Mark A. Mintun*, Andrei G. Vlassenko, Melissa M. Rundle, and Marcus E. Raichle

Mallinckrodt Institute of Radiology, Washington University School of Medicine, 510 South Kingshighway Boulevard, St. Louis, MO 63110

Contributed by Marcus E. Raichle, November 10, 2003

The factors regulating cerebral blood flow (CBF) changes in physiological activation remain the subject of great interest and debate. Recent experimental studies suggest that an increase in cytosolic NADH mediates increased blood flow in the working brain. Lactate injection should elevate NADH levels by increasing the lactate/pyruvate ratio, which is in near equilibrium with the NADH/NAD\(^+\) ratio. We studied CBF responses to bolus lactate injection at rest and in visual stimulation by using positron-emission tomography in seven healthy volunteers. Bolus lactate injection augmented the CBF response to visual stimulation by 38–53% in regions of the visual cortex but had no effect on the resting CBF or the whole-brain CBF. These lactate-induced CBF increases correlated with elevations in plasma lactate/pyruvate ratios and in plasma lactate levels but not with plasma pyruvate levels. Our observations support the hypothesis that an increase in the NADH/NAD\(^+\) ratio activates signaling pathways to selectively increase CBF in the physiologically stimulated brain regions.

The aim of this study was to evaluate the effect of acute lactate injection on regional CBF at rest and during task-specific functional activity in neurologically normal subjects.

Materials and Methods

Subjects. Seven healthy, right-handed (12) subjects, four females and three males (ages 20–27 years; mean age ± SD was 24.0 ± 2.4 years), were recruited from the Washington University community. The Humans Studies Committee and the Radioactive Drug Research Committee of our institution approved the protocol of this study. Written informed consent was obtained.

PET Imaging. All subjects underwent a single PET session consisting of six CBF scans. Studies were done with a Siemens/CTI ECAT EXACT HR 47 tomograph (Iselin, NJ) (13). This scanner collects 47 simultaneous slices with 3.125-mm spacing encompassing an axial field of view of 15 cm. Transaxial resolution is improved with the use of a 128 x 128 x 40 matrix.
rate (rGMR) decreased in all measured cortical regions as exercise intensity increased. The mean decrease between the highest and lowest exercise intensity was 32% globally in the brain (38.6 ± 4.6 versus 26.1 ± 5.0 μmol (100 g)⁻¹ min⁻¹, P < 0.001). Lactate availability during exercise tended to correlate negatively with the observed brain glucose uptake. In addition, the decrease in glucose uptake in the dorsal part of the anterior cingulate cortex (37% versus 20%, P < 0.05 between 30% and 75% of \( \dot{V}_{O_2,\text{max}} \)) was significantly more pronounced in subjects with higher exercise capacity. These results demonstrate that brain glucose uptake decreases with increase in exercise intensity. Therefore substrates other than glucose, most likely lactate, are utilized by the brain in order to compensate the increased energy needed to maintain neuronal activity during high intensity exercise. Moreover, it seems that exercise training could be related to adaptive metabolic changes locally in the frontal cortical regions.

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Corresponding author J. Knuuti: Turku PET Centre, University of Turku, PO Box 52, 20521 Turku, Finland.
Email: juhani.knuuti@tyks.fi
Lactate administration reproduces specific brain and liver exercise-related changes

Lezi E,*† Jiahua Lu,*† J. Eva Selfridge,§ Jeffrey M. Burns*†§ and Russell H. Swerdlow*†§¶

*University of Kansas Alzheimer's Disease Center, Kansas City, Kansas, USA
†Department of Physical Therapy and Rehabilitation Science, University of Kansas Medical Center, Kansas City, Kansas, USA
‡Department of Neurology, University of Kansas Medical Center, Kansas City, Kansas, USA
§Department of Molecular and Integrative Physiology, University of Kansas Medical Center, Kansas City, Kansas, USA
¶Department of Biochemistry and Molecular Biology, University of Kansas Medical Center, Kansas City, Kansas, USA
Weight training is a disease-modifying treatment for PD

The impact of high intensity physical training on motor and non-motor symptoms in patients with Parkinson's disease (PIP): A preliminary study.
Morberg BM, Jensen J, Bode M, Wermuth L.

Abstract

BACKGROUND: Parkinson's disease (PD) is a neurodegenerative disease caused by loss of dopaminergic nigrostriatal neurons. Several studies have investigated various physical interventions on PD. The effects of a high intensity exercise program with focus on resistance; cardio; equilibrium; and flexibility training have not been evaluated previously.

OBJECTIVE: The aim of this study was to investigate the effects of a complex, high intensity physical training program, with a long duration, on motor and non-motor symptoms in patients with PD.

METHOD: 24 patients with PD Hoehn and Yahr stage 1-3 were non-randomly allocated to an intervention group (n = 12) and a control group (n = 12). The intervention group underwent 32 weeks of high intensity personalized physical training twice a week, with an optional extra training session once a week. The control group received general recommendations regarding physical activity. The primary outcomes were the change in Unified Parkinson's Disease Rating Scale Subscores (UPDRS) and the Parkinson's Disease Questionnaire (PDQ-39).

RESULTS: At week 32, the training significantly improved both UPDRS motor subscores (p = 0.045), activities of daily living subscores (ADL) (p = 0.006), mentation subscores (p = 0.004) and complication subscores (p = 0.019). The effect on the PDQ39 total score was not statistically significant. The intervention group however experienced a substantial improvement of the PDQ39 items emotional well-being (-11.0) and bodily discomfort (-7.14).

CONCLUSION: The results suggest that a personal high intensity exercise program may favorably influence both motor and non-motor symptoms in patients with mild to moderate PD. More studies with both higher methodology in study design and a follow-up examination are recommended.

BEWARE PLACEBO EFFECT
Weight training is a disease-modifying treatment for PD

A Two-Year Randomized Controlled Trial of Progressive Resistance Exercise for Parkinson’s Disease

Daniel M. Corcos, PhD,1 Julie A. Robichaud, PT, PhD,1 Fabian J. Davids, PhD,1 Sue E. Leurgans, PhD,1,2
David E. Vaillancourt, PhD,3 Cynthia Poon, PhD,1 Miriam R. Rafferty, DPT,4 Wendy M. Kohrt, PhD,5 Cynthia L. Comella, MD3

1Department of Kinesiology and Nutrition, University of Illinois at Chicago, Chicago, Illinois, USA
2Department of Bioengineering and Psychology, University of Illinois at Chicago, Chicago, Illinois, USA
3Department of Neurological Sciences, Rush University Medical Center, Chicago, Illinois, USA
4Department of Preventive Medicine, Rush University Medical Center, Chicago, Illinois, USA
5Departments of Applied Physiology and Kinesiology, Biomedical Engineering, and Neurology, University of Florida, Gainesville, Florida, USA
6Graduate Program in Neuroscience, University of Illinois at Chicago, Chicago, Illinois, USA
7Division of Geriatric Medicine, University of Colorado School of Medicine, Aurora, Colorado, USA

ABSTRACT: The effects of progressive resistance exercise (PRE) on the motor signs of Parkinson’s disease have not been studied in controlled trials. The objective of the current trial was to compare 6-, 12-, 18-, and 24-month outcomes of patients with Parkinson’s disease who received PRE with a stretching, balance, and strengthening exercise program. The authors conducted a randomized controlled trial between September 2007 and July 2011. Pairs of patients matched by sex and off-medication scores on the Unified Parkinson’s Disease Rating Scale, motor subscale (UPDRS-III), were randomly assigned to the interventions with a 1:1 allocation ratio. The PRE group performed a weight-lifting program. The modified fitness counts (mFC) group performed a stretching, balance, and strengthening exercise program. Patients exercised 2 days per week for 24 months at a gym. A personal trainer directed both weekly sessions for the first 6 months and 1 weekly session after 6 months.

The primary outcome was the off-medication UPDRS-III score. Patients were followed for 24 months at 6-month intervals. Of 51 patients, 20 in the PRE group and 18 in the mFC group completed the trial. At 24 months, the mean off-medication UPDRS-III score decreased more with PRE than with mFC (mean difference, −7.3 points; 95% confidence interval, −11.3 to −3.6; P<0.001). The PRE group had 10 adverse events, and the mFC group had 7 adverse events. PRE demonstrated a statistically and clinically significant reduction in UPDRS-III scores compared with mFC and is recommended as a useful adjunct therapy to improve Parkinsonian motor signs.

© 2013 Movement Disorder Society

Key Words: Parkinson’s disease; progressive resistance exercise; strength training; randomized controlled trial; Unified Parkinson’s Disease Rating Scale motor subscale
Weight training is a disease-modifying treatment for PD (a comparable drug would sell in excess of $1B per year)

A Two-Year Randomized Controlled Trial of Progressive Resistance Exercise for Parkinson’s Disease

<table>
<thead>
<tr>
<th>Outcome measure</th>
<th>Score at visit: Mean±SD</th>
<th>Change from baseline: Mean±SD</th>
<th>Difference in change from baseline: PRE vs mFC (95% CI)</th>
<th>( P^a )</th>
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<tr>
<td></td>
<td>mFC</td>
<td>PRE</td>
<td>mFC</td>
<td>PRE</td>
</tr>
<tr>
<td>Baseline</td>
<td>34.7±11.5</td>
<td>34.5±11.9</td>
<td>-5.4±2.8</td>
<td>-6.4±3.0</td>
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<tr>
<td>6 mo</td>
<td>29.3±12.2</td>
<td>28.0±10.9</td>
<td>-1.7±3.7</td>
<td>-5.8±3.2</td>
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<tr>
<td>12 mo</td>
<td>32.8±12.4</td>
<td>28.4±10.8</td>
<td>-0.9±8.1</td>
<td>-4.7±7.0</td>
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<tr>
<td>18 mo</td>
<td>32.8±12.3</td>
<td>28.5±9.4</td>
<td>-0.1±8.7</td>
<td>-7.4±7.4</td>
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<td>24 mo</td>
<td>34.0±12.6</td>
<td>25.8±10.6</td>
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**ABSTRACT:** The effects of progressive resistance exercise (PRE) on the motor signs of Parkinson’s disease have not been studied in controlled trials. The objective of the current trial was to compare 6-, 12-, 18-, and 24-month outcomes of patients with Parkinson’s disease who received PRE with a stretching, balance, and strengthening exercise program. The authors conducted a randomized controlled trial between September 2007 and July 2011. Pairs of patients matched by sex and off-medication scores on the Unified Parkinson’s Disease Rating Scale, motor subscale (UPDRS-III), were randomly assigned to the interventions with a 1:1 allocation ratio. The PRE group performed a weight-lifting program. The modified fitness counts (mFC) group performed a stretching, balance, and strengthening exercise program. Patients exercised 2 days per week for 24 months at a gym. A personal trainer directed both weekly sessions for the first 6 months and 1 weekly session after 6 months. The primary outcome was the off-medication UPDRS-III score. Patients were followed for 24 months at 6-month intervals. Of 51 patients, 20 in the PRE group and 18 in the mFC group completed the trial. At 24 months, the mean off-medication UPDRS-III score decreased more with PRE than with mFC (mean difference, -7.3 points; 95% confidence interval, -11.3 to -3.6; \( P<0.001 \)). The PRE group had 10 adverse events, and the mFC group had 7 adverse events. PRE demonstrated a statistically and clinically significant reduction in UPDRS-III scores compared with mFC and is recommended as a useful adjunct therapy to improve Parkinsonian motor signs. © 2013 Movement Disorder Society

**Key Words:** Parkinson’s disease; progressive resistance exercise; strength training; randomized controlled trial; Unified Parkinson’s Disease Rating Scale motor subscale
It is very costly (at least $300M) to prove the efficacy of treatments that slow disease progression.

Pharma companies are reluctant to take the risk, but insurers should emphasize preventative treatments, like KAATSU.
Identification of aged Individuals who are 2-4 years away from PD diagnosis is possible and practical

Olfactory dysfunction (lowest 15 %)

These patients have ca 10-fold elevated risk, that is, 10% of them will be diagnosed with in 5 years

Of hyposmic patients who are imaged, those in the lowest 10-20% of DA neurons are very likely (ca 50%) to be diagnosed within five years

WHY NOT TREAT ALL 60+ HYPOSMIC PATIENTS WITH KAATSU?
Treating prodromal PD patients with KAATSU could effectively “cure” some patients, that is, they will never reach the threshold for diagnosis.

This trial is called a “conversion trial” and it measures the % of each group that are diagnosed after a given time. These trials can be very long.
Parkinson’s disease is an ideal target for KAATSU therapy
Presentation 2
Robert Heiduk
Sports Scientist, Universität Bonn
Business development in the German speaking area

Germany, Austria, Switzerland
Purpose of this presentation

- How we try to popularize KAATSU in the german speaking countries
- Provide some characteristics about our business
- Draw some reasonable conclusions about KAATSU future development
- Initiate active discussion
What could be the next big thing to change the sports, health and fitness industry?
FIBO 2015, Cologne: Steven, Marek & Robert
sports scientist, trainer & speaker

„Bridging the gap between science and practice“
Marek, pullsh founder:
Typical strength & conditioning products
Toshiaki Nakajima, Ph.D.
KAATSU Germany premiere on the preconference of Athletik Konferenz 2015
Our niche strategy: Top down method

- Sports Science Sector
- Competitive Sport
- Rehabilitation Sector
- Personal Training Sector
- Health Sector
  - Medical fitness
  - Micro fitness center
micro fitness center: lifestyle trend in german major cities

EMS: electrical muscle stimulation
A world wide forward movement

KAATSU could become a business model like EMS
Sails efforts to popularize KAATSU

• Visiting prospective KAATSU customers in their own locations: pullsh customers, sport universities, olympic training centers, personal trainers
• Visit the big german health fairs: Medica, FIBO, Personal Trainer Conference, & other pro sports events
• Write articles for relevant fitness industry magazines
• Translate education material in German language
• KAATSU website in German language
• Share KAATSU Global news and translate (facebook)
• Publish video testimonials from relevant people
• Clarify between terminology, e.g. occlusion training
• Let people experience how (correct) KAATSU feels → wow-effect
Goals until 2017

Germany
Berlin, Hamburg, Munich, Cologne, Frankfurt, Stuttgart

Austria
Vienna

Switzerland
Basel, Zürich, Bern
<table>
<thead>
<tr>
<th>Differences between KAATSU and Blood Flow Restriction Training (BFR)</th>
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<tbody>
<tr>
<td><strong>KAATSU</strong> (Japanese meaning: additional pressure)</td>
</tr>
<tr>
<td>Physiologically accurate term:</td>
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<tr>
<td>Blood Flow Moderation*, patented by</td>
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<tr>
<td>Dr. Yoshiaki Sato</td>
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<td></td>
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<tr>
<td><strong>KAATSU</strong> Master</td>
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<td><strong>KAATSU</strong> Nano</td>
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<td><strong>KAATSU</strong> Cycle</td>
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<tr>
<td><strong>Sensor-monitored Pneumatic Air Bands</strong></td>
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<tr>
<td>- high standardization</td>
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<tr>
<td>- inflate with empirical data</td>
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<tr>
<td>- movement is not restricted</td>
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<tr>
<td>- proven safe after millions of sessions</td>
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<tr>
<td><strong>Base SKU</strong></td>
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<tr>
<td><strong>Optimal SKU</strong></td>
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<tr>
<td><strong>Pressure</strong></td>
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<tr>
<td><strong>High</strong></td>
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<tr>
<td>- daily variable to meet individual needs</td>
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<tr>
<td>- dependent on individual's age &amp; fitness level</td>
</tr>
<tr>
<td><strong>High</strong></td>
</tr>
<tr>
<td>- daily variable</td>
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<tr>
<td>- ability to measure and store individual data</td>
</tr>
<tr>
<td><strong>Standardized protocols</strong></td>
</tr>
<tr>
<td><strong>Training</strong></td>
</tr>
<tr>
<td>Protocols for performance training,</td>
</tr>
<tr>
<td>recovery, therapy, resistance training</td>
</tr>
<tr>
<td>Since 1966 with 300.000+ daily sessions</td>
</tr>
</tbody>
</table>
Toshiaki Nakajima, Ph.D.

KAATSU

High metabolic Stress

Low mechanical tension

Different responses in
- Muscle fibre recruitment
- Mechanotransduction
- Muscle cell damage
- Disturbance of homeostasis
- Hormonal response characteristics
- Muscle cell swelling
- Anabolic pathways
- Production of Nitric Oxide
- Recovery time

Traditional Strength Training

Low metabolic Stress

High mechanical tension
KAATSU: Trend Or Fad?

**Trend:** “a general development or change in a situation or in the way that people are behaving”
http://dictionary.cambridge.org/us/

**Fad:** “a fashion that is taken up with great enthusiasm for a brief period”
http://dictionary.reference.com/
# KAATSU - Top 20 until 2020?

**Table 2: Top 20 Worldwide Fitness Trends for 2016**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wearable technology</td>
</tr>
<tr>
<td>2</td>
<td>Body weight training</td>
</tr>
<tr>
<td>3</td>
<td>High-intensity interval training (HIIT)</td>
</tr>
<tr>
<td>4</td>
<td>Strength training</td>
</tr>
<tr>
<td>5</td>
<td>Educated, certified, and experienced fitness professionals</td>
</tr>
<tr>
<td>6</td>
<td>Personal training</td>
</tr>
<tr>
<td>7</td>
<td>Functional fitness</td>
</tr>
<tr>
<td>8</td>
<td>Fitness programs for older adults</td>
</tr>
<tr>
<td>9</td>
<td>Exercise and weight loss</td>
</tr>
<tr>
<td>10</td>
<td>Yoga</td>
</tr>
<tr>
<td>11</td>
<td>Group personal training</td>
</tr>
<tr>
<td>12</td>
<td>Worksite health promotion</td>
</tr>
<tr>
<td>13</td>
<td>Wellness coaching</td>
</tr>
<tr>
<td>14</td>
<td>Outdoor activities</td>
</tr>
<tr>
<td>15</td>
<td>Sport-specific training</td>
</tr>
<tr>
<td>16</td>
<td>Flexibility and mobility rollers</td>
</tr>
<tr>
<td>17</td>
<td>Smart phone exercise apps</td>
</tr>
<tr>
<td>18</td>
<td>Circuit training</td>
</tr>
<tr>
<td>19</td>
<td>Core training</td>
</tr>
<tr>
<td>20</td>
<td>Outcome measurements</td>
</tr>
</tbody>
</table>
KAATSU - More than a trend

- BFR/BFM completely new field of exercising
- KAATSU is the inventor of the BFR/BFM technique
- Over 40 years of research and experience in this field
- Hundreds of thousands of people per day using KAATSU, it is truly proven safe and effective
- Versatile application in sports, healthcare, beauty & rehabilitation
- Good story to bring KAATSU to the market, clients, athletes and customers
Presentation 3
John Murray
Murray Athletic Development
2015 KAATSU International Symposium
Murray Athletic Development
Presents:
“3- Legged Dog Therapy”

Practical Applications of KAATSU in a Physical Therapy Clinic
November 5, 2015

Presenter:
John Murray
“Training is the psychological and physiological conditioning of an individual preparing for intense neural and muscular reaction. It implies discipline of the mind and power and endurance of the body. It means skill. It is all these things working together in harmony.”

Bruce Lee
Physical Therapy is physical *and* PSYCHOLOGICAL rehabilitation.

The mind is key.
“80% of the game is MENTAL”

“The mental part is the hardest part and I think that’s the part that separates the good players (patients) from the great players (patients).”

Michael Jordan
Arthur J. Ting, M.D. Orthopedic Surgery and Sports Medicine

P.T. Approach: 3 Legged Dog Therapy
Focus on what you CAN do; not on what you can’t.
Doing what you **can** do breeds confidence.
Let your mind go and your body will follow.
P.T. Identity:

- You are not just a patient.
- You are an individual.
- You are a human athlete.
You cannot sleep walk through physical therapy.

- Our bodies are designed to move.
- Move your body!
- We want to return you to what you LOVE to do.
Todd Tissue - Professional Big Wave Surfer
AMS – Athletic Mind Set

KAATSU empowers people to “attack” their therapy.
Monta Ellis - Professional Basketball Player, Indiana Pacers Guard, NBA
“KAATSU trains the mind AND the body.”
Monta Ellis

The KAATSU “Aha!” moment.
• KAATSU reintroduces Athletes to “Positive Pain”.

• People begin to feel ALIVE again.

• Mind and body are forced to connect.
Practical Application:

Identify what person loves to do and begin to do it wearing KAATSU bands.
Practical Application:

Customize exercise movements.
P.T. is a Step by Step Process.

“Skill development is a step-by-step process. Step 1 to Step 2 etc....Not Step 1 to Step 4 to Step 7. You can’t skip steps.”

Coach Merv Lopes
KAATSU accelerates Step by Step development.
Acknowledge and celebrate each step attained.
- KAATSU’S positive impact on Dr. Ting patients

- KAATSU is not a panacea.

- It is not magic.

- KAATSU empowers the body to be its best.
“We are what we repeatedly do. Excellence, then, is not an act but a habit.”

Aristotle
“You have to be able to get comfortable being uncomfortable”

Coach Pete Newell
Thank you!
Presentation 4
Chris Morgan
2008 Olympic Swim Coach
Former Assistant Swim Coach at Stanford & Harvard
KAATSU TRAINING in the AQUATIC COMMUNITY

Olympic Swim Coach and Certified KAATSU specialist

CHRIS MORGAN
My KAATSU journey...

Beijing 2008
STANFORD & HARVARD
Bad Luck to MIRACLE??
ATHLETE: Sara Li (Harvard)

- Starting Using KAATSU aqua in August 2012
- Primarily 2x per week for Sprint Training
- Performance:
  - 200 freestyle pre KAATSU: 1:50
  - 200 freestyle post KAATSU: 145.8
  - Harvard Record (~4.5 months after KAATSU)
Athlete: Carson Christuck (16)

- Background: Experienced 2 major injuries in 2013
- Injuries: Broke his wrist and dislocated his knee cap
- Frequency: performed KAATSU Aqua 3 times per week
- Impression: KAATSU Aqua has helped reduce and occasionally eliminate the lingering pain
Carson Continued...

- **Performance: 200 breaststroke best times**
  - 2:14 in September 2013
  - 2:11 in December 2013 (taper meet)
- **Started KAATSU Aqua in January 2014**
  - 2:09 in February 2014 (unrested and unshaved)
  - 2:03 in April 2014 at YMCA National Championships
Athlete: Vyacheslav Chereukhin
“Slava”

- Left Shoulder – Potential Rotator Cuff Tear
- 6 months of KAATSU cycle, 3-point exercises and KAATSU Aqua
- Results: able to swim pain free for 1st time in 1.5 years, able to lift weights pain free, has felt increase in leg capacity in the water.
Athlete: Maddie Wallis (15)

- Injury: Severe Bicipital Tendonitis / Rotator Cuff
- Rehab: KAATSU cycle, 3-point, KAATSU training specific to swimming, KAATSU aqua
- Duration: 4 months (3-4x per week)
- Results: able to swim pain free for 30-45 minutes longer
- Performance: TBD
Athlete: Andrea Almeida Marques

- 48 year old Masters swimmer
- Injury: 10 year Shoulder Pain, could not use paddles or any resistance training, trouble with shooting pain while sleeping
- Rehab: KAATSU cycle, 3-point exercises, KAATSU Aqua
- Duration: 4x per week, for 3 weeks and pain diminished quickly
- Currently: 3x per week and remains pain free...
Athlete: Andrea Almeida Marques (cont.)
Athlete: Roy Burch (Olympic Swimmer from Bermuda)

- Injury: Double Platellar Tendon Rupture
- KAATSU: Began 5 weeks post operation
- Rehab: 2x per day KAATSU Cycle (everyday), KAATSU training 3x per week on arms
- Increased mobility and Strength after 1 week
- Back in water after 16 days of KAATSU
- Starts and Turns after 1 month of KAATSU
- Will continue KAATSU training towards RIO 2016
Athlete: Roy Burch (Olympic Swimmer from Bermuda)
Swiss National Team

- ~1 year with National Coaches Dirk Reinicke & Nico Messer
- 5-8 athletes currently using KAATSU 3-4x per week
- Injuries (shoulders) vastly decreased
- Performance has increased (WC, OG)
KAATSU Aqua Users

Water Polo Players (teenage), KAATSU Aqua test in 2013

Groups: 16 players were divided into 2 groups for 3 weeks with 11 sessions

Tests: 10 x 50 sprint freestyle on a 1:15 interval conducted 3 weeks apart (parent volunteers timed each player’s 10 x 50s with stopwatches)

KAATSU Arms: Sets included 200 warm-up + 4 x 50 freestyle + 4 x 50 freestyle (25 easy + 25 hard) + 200 IM + 4 x 75 + 4 x 25 sprint (at 120 mmHg)

KAATSU Legs: Sets included 4 x 25 sprint, 4 x 50 (kick + sprint) + 4 x 50 + 4 x 75 + 4 x 25 sprint (at 140 mmHg)

Results:

<table>
<thead>
<tr>
<th></th>
<th>Pre-test Time</th>
<th>Post-Test Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-users:</td>
<td>32.25</td>
<td>32.23 (first 50 time)</td>
</tr>
<tr>
<td>Users:</td>
<td>31.56</td>
<td>30.32</td>
</tr>
<tr>
<td>Non-users:</td>
<td>33.90</td>
<td>33.77 (average 50 time)</td>
</tr>
<tr>
<td>Users:</td>
<td>33.96</td>
<td>32.38</td>
</tr>
<tr>
<td>Non-users:</td>
<td>34.58</td>
<td>34.13 (average of last five 50s)</td>
</tr>
<tr>
<td>Users:</td>
<td>34.84</td>
<td>32.97</td>
</tr>
</tbody>
</table>

Conclusions: 4% increase in speed, 4.6% increase in exercise endurance, 5.37% increase in last half of test by KAATSU users

Coach: Uros Dzelebdzic, Vanguard Aquatics (California)
Presentation 5
Paul Grzymkowski
Former president of Gold’s Gym International
KAATSU’s Mission

KAATSU Global is dedicated to offering equipment and know-how to rehabilitate and exercise individuals of all ages and abilities through blood flow moderation that enables unprecedented efficiency in strengthening muscle and improving vascular wellness, either as a means of preventive medical care or as a form of athletic performance enhancement.
KAATSU....... the New Horizon for Personal Health and Sports Performance

“Using the science of KAATSU to empower informed general health and training decisions”
The KAATSU Approach

**Step 1**
Research the most innovative KAATSU health systems and training protocols

**Step 2**
This becomes the foundation for our health services and solutions

**Step 3**
These services and solutions optimize lifelong wellness & health, avert potential illness and increase performance

**Step 4**
We track the progress and success rates of KAATSU clients and health care professionals

**Step 5**
This information is fed back into our research and data collection network
The Fitness/Wellness Market

- In 2014, U.S. fitness centers had a total membership of over 54 million. The U.S. fitness centers market consists of about 34,000 membership based exercise facilities. Fitness centers are operated as parts of multi-site chains or as single-location entities.
North America is the region with the largest membership base for fitness centers in the world. The total fitness center industry revenue in the U.S. amounted to over 24 billion U.S. dollars in 2014, almost 90 percent of the region’s total revenue. Europe is the second biggest market for the health club industry, followed by the Asia-Pacific region.
<table>
<thead>
<tr>
<th>Company</th>
<th>Number of clubs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anytime Fitness</td>
<td>2,739</td>
</tr>
<tr>
<td>Snap Fitness</td>
<td>1,434</td>
</tr>
<tr>
<td>Planet Fitness</td>
<td>918</td>
</tr>
<tr>
<td>Gold's Gym International</td>
<td>689</td>
</tr>
<tr>
<td>L.A. Fitness International, LLC</td>
<td>630</td>
</tr>
<tr>
<td>Mrs. Sporty</td>
<td>554</td>
</tr>
<tr>
<td>24 Hour Fitness USA, Inc.</td>
<td>450</td>
</tr>
<tr>
<td>Fitness First</td>
<td>370</td>
</tr>
<tr>
<td>Health City / Basic-Fit</td>
<td>350</td>
</tr>
<tr>
<td>GoodLife Fitness and Énergie Cardio</td>
<td>327</td>
</tr>
</tbody>
</table>
Combining health, fitness and wellness.

A team approach - MD, Chiropractor, Physical Therapist and Personal Trainer work together to help people achieve optimal health and fitness performance.
A portion of a fitness or health facility is dedicated to KAATSU’s ProActive Health (Training) Program.

The Center integrates a customized blend of KAATSU Health and Training Protocols into their facility creating the KAATSU ProActive Health Program.
Wellness Salon & Studio Concept
Salon/Studio Concept Workout Room
Wellness Salon
Reception Desk
Group Lounge
Wellness Salon
KAATSU

Leading the way...
Assessing the Use of KAATSU to Improve Vascular Health

- Brief understanding of vascular pathophysiology and how we can measure endothelial function with AngioScan to show improvements using KAATSU.

- From measuring pre and post KAATSU with AngioScan we feel that the KAATSU is an incredible modality in the prevention of cardiovascular disease.

- The effects of KAATSU on stress and heart rate variability.
Steve Munatones
KAATSU GLOBAL

Dr. Michael Kessler D.C.,
C.C.S.P.
Educator and Trainer

Dr. Sondra Becchetti, D.C., FIACA
Corporate Coordinator

Dr. Javadat Karimov, MD.,
NMD
Designer and Innovator

Global Health Solutions, LLC
Common Bond with Dr. Sato. We are both Judoka
Healthy Aging Requires Healthy Arteries and a Healthy Heart

AngioScan provides early detection of vascular changes before major symptoms of health issues such as strokes and cardiovascular disease occur.

Clinical Studies show that continued Kaatsu Training rejuvenates and increases the number of vascular endothelial cells by facilitating the secretion of Nitric Oxide.
Facts on Cardiovascular Disease

- Cardiovascular disease (CVD) is the nation’s leading killer
- Almost 1 million Americans die of CVD each year
- 42% of all deaths are attributed to CVD
- Heart disease doesn’t just kill the elderly...
  - It is the leading cause of death for ALL Americans age 35 and older
  - 16% of CVD deaths occur in individuals 35 to 64 years old

Source: http://www.americanheart.org
When should we start screening?

AngioScan Evaluation

- Norm
- Endothelial dysfunction
- Stenosis
- Stenosis > 50%
- Atherothrombosis

20 - 30 years
Nitric Oxide

“The Miracle Molecule”

Dr. Louis J. Ignarro discovered "the atom" of cardiovascular health—a tiny molecule called Nitric Oxide. His research won him the Nobel Peace Prize in 1998.

Nitric Oxide can prevent (even reverse) Heart Disease and Stroke
Vascular Effects of Nitric Oxide

In a healthy endothelium, Nitric Oxide has many beneficial actions.

**Nitric Oxide:**

1. Keeps blood vessels pliable and elastic
2. Helps blood to circulate smoothly
3. Regulates platelet formation and prevents adhesion
Vascular Effects of Nitric Oxide

4. Regulates oxidative enzymes in the cell, preventing oxidation
5. Reduces growth and multiplication of muscle cells that thicken the vessel wall
6. Slows plaque growth and suppresses atherosclerosis
7. May help control any arterial plaque that forms
Hypertension is not a disease but is a marker for endothelial and vascular dysfunction. An elevated blood pressure is one of many responses of the blood vessel to endothelial dysfunction, vascular smooth muscle dysfunction and impaired microvascular function and structure. Endothelial dysfunction and microvascular smooth muscle dysfunction precede the development of hypertension by decades.
Hypertension is a Disease of the Blood Vessel with Maladaptive Responses

*Curr Opin Nephrol and Hypertension 2012;21:119-121*

Hypertension is a disease of the blood vessels

Hypertension is a “vasculopathy” characterized by

1. Endothelial dysfunction
2. Structural remodeling
3. Vascular inflammation
4. Increased arterial stiffness
5. Reduced distensibility and loss of elasticity as seen on the AngioScan
Old thinking a few risk factors: Blood sugar, Obesity, Hypertension, Smoking, Stress, Poor Diet Lack of Exercise and Hyperlipidemia
Can we trust traditional brachial blood pressure?

Mark Houston, M.D. MSC, ABAARM,FACN,FACP, FAHA, FASH Associate Clinical professor of Medicine Vanderbilt Univ. School of Medicine

We can have terrible vascular health and have a normal BP
What do we use to replace the Dinosaurs?
Parameters of AngioScan

- Pulse wave type A B C
- Heart Rate
- Vascular Stiffness (Large Arteries)
- Vascular Age (Small-Medium Vessles)
- Stress Index
- Oxygen Saturation
Photoplethysmogram is the technology that uses a finger probe similar to a pulse oximeter and shines visible red and infrared light into the finger tip. This can indicate the volume of blood passing in or out of the artery. With this technology we are measuring a pulse wave the heart produces when the left ventricle contracts during systole.

- Estimates Large Artery Stiffness from the pulse wave form obtained at the finger using an infrared sensor (photoplethysmography). The speed at which the pulse travels along the arterial tree is directly related to arterial stiffness
Why AngioScan

The AngioScan measures pulse wave velocity that gives a good indication of arterial stiffness and is a good indication of cardiovascular risk. With this analysis we can see if exercise, diet and nutritional changes are helping to improve vascular health. Thomas Sidnum from the Royal Society of Medicine in the 1600 stated that man is only as old as his arteries.

**The higher the pulse wave velocity a patient has, the shorter is the life span according to research.** A score of under 9.4 meters per second fairs well. This is because over a period of 140 months 85% of the standard patients with this reading were still alive. The patients at the beginning of the study with a pulse wave velocity between 9.4 and 12 meters per second also did fairly well with 75% surviving over 140 month period. Those with pulse wave velocities with over 12 meters per second had only a 10% survival over the 140 month period.
AHA Scientific Statement

Recommendations for Improving and Standardizing Vascular Research on Arterial Stiffness
A Scientific Statement From the American Heart Association

Raymond R. Townsend, MD, FAHA, Chair;
Ian B. Wilkinson, MD, DM, FRCP, FAHA, Vice Chair;
Ernesto L. Schiffrin, MD, PhD, FAHA, Vice Chair; Alberto P. Avolio, BE, PhD;
Julio A. Chirinos, MD, PhD, FAHA; John R. Cockcroft, FRCP; Kevin S. Heffernan, PhD;
Edward G. Lakatta, MD; Carmel M. McEniery, PhD; Gary F. Mitchell, MD;
Samer S. Najjar, MD; Wilmer W. Nichols, PhD; Elaine M. Urbina, MD, MS, FAHA;
Thomas Weber, MD; on behalf of the American Heart Association Council on Hypertension

Much has been published in the past 20 years on the use of measurements of arterial stiffness in animal and human research studies. This summary statement was commissioned by the American Heart Association to address issues concerning the nomenclature, methodologies, utility, limitations, and gaps in knowledge in this rapidly evolving field. The following represents an executive version of the larger online-only Data Supplement and is intended to give the reader a sense of why arterial stiffness is important, how it is measured, the situations in which it has been useful, its limitations, and questions that remain to be addressed in this field. Throughout the document, pulse-wave velocity (PWV; measured in meters per second) and variations such as carotid-femoral PWV (cfPWV; measured in meters per second) are used. PWV without modification is used in the general sense of arterial stiffness. The addition of lowercase modifiers such as “cf” is used when speaking of specific segments of the arterial circulation.

The ability to measure arterial stiffness has been present for many years, but the measurement was invasive in the early times. The improvement in technologies to enable repeated,

In the ≈3 decades of clinical use of PWV measures in humans, we have learned much about the importance of this parameter. PWV has proven to have independent predictive utility when evaluated in conjunction with standard risk factors for death and cardiovascular disease (CVD). However, the field of arterial stiffness investigation, which has exploded over the past 20 years, has proliferated without logistical guidance for clinical and translational research investigators. This summary statement, commissioned by the American Heart Association Council on Hypertension, represents an effort to provide such guidance, drawing on the expertise of experienced clinical and basic science investigators in Europe, Australia, and the United States. Recommendations made in this statement are assumed to refer to the research aspect of arterial stiffness investigations, unless accompanied by language that emphasizes clinical use as well, and are based on the grid shown in Table 1.

Section 1. What Is Arterial Stiffness?
Recommendation
Contour analysis of the photoplethysmographic pulse measured at the finger
Sandrine C. Millasseau, James M. Ritter, Kenji Takazawa and Philip J. Chowienczyk

Analysis of the contour of the peripheral pulse to assess arterial properties was first described in the nineteenth century. With the recognition of the importance of arterial stiffness there has been a resurgence of interest in pulse wave analysis, particularly the analysis of the radial pressure pulse acquired using a tonometer. An alternative technique utilizes a volume pulse. This may conveniently be acquired optically from a finger (digital volume pulse). Although less widely used, this technique deserves further consideration because of its simplicity and ease of use. As with the pressure pulse, the contour of the digital volume pulse is sensitive to changes in arterial tone induced by vasoactive drugs and is influenced by ageing and large artery stiffness. Measurements taken directly from the digital volume pulse or from its second derivative can be used to assess these properties. This review describes the background to digital volume pulse contour analysis, how the technique relates to contour analysis of the pressure pulse, and current and future applications. J Hypertens 24:1449–1456 © 2006 Lippincott Williams & Wilkins.

Keywords: photoplethysmography, pulse wave analysis, arterial stiffness

*Cardiovascular Division, King's College London School of Medicine, London, UK and Department of Internal Medicine, Tokyo Medical University Hospital, Tokyo, Japan

Correspondence and requests for reprints to Prof. P. Chowienczyk, Department of Clinical Pharmacology, St Thomas' Hospital, Lambeth Palace Road, London, SE1 7EH. UK. Tel: +44 20 7188 1564; fax: +44 20 7401 2242; email: phil.chowienczyk@kcl.ac.uk

Sponsorship: S.C.M. was funded by Micor Medical Ltd. P.J.C. has grant support from Micor Medical and Oxren Health Care. Conflict of interest: S.C.M. was funded by Micor Medical Ltd through a programme of pulse wave measurement. P.J.C. was a shareholder and director of Micor Medical Ltd until March 2005, and has grant support from Micor Medical and Oxren Health Care.

Received 15 November 2005; Revised 10 January 2006; Accepted 12 February 2006

Conclusion
Optical determination of the DVP is a particularly simple method for performing pulse contour analysis. Like the pressure pulse, the DVP is influenced by large artery stiffness and by pressure wave reflection in the systemic vasculature. Contour analysis of the DVP provides a rapid means of assessing vascular tone and arterial stiffness. Applications include the assessment of endothelial function, arterial stiffness and characterization of arterial ageing.
Pulse Wave Types

Arterial Supply
Venous Return
Photo-Detector
Detector

If the returning wave returns too fast in early systole, the heart has to work against itself and the heart has less time to relax. This means the heart cannot get its own blood supply when it is contracting and you end up with more ischemia, heart attacks and stroke.
Contour Analysis Curve Type C (24 years)

Vascular Aging

Good condition of the arteries.

22 years
Do you know your CASP?

To calculate the CASP you take the patient’s systolic BP and either add it to the vascular stiffness number or subtract it if it is a negative number.

EXAMPLE: Blood pressure is 140/90 and Vascular Stiffness is +25. Their CASP would be 165. According to the charts on the left, if this person is a male a CASP reading of 165 needs to be evaluated immediately.

Pressures Requiring Cardiac Work-Up or Referral:

- **BLOOD PRESSURE:**
  - BP higher than 160/100 requires referral
  - BP higher than 180/110 referral to ER

- **CASP:**
  - Anything over 155 referral to cardiologist
  - 160 to 165 refer to ER

**PP = Pulse Pressure** = difference between systolic and diastolic pressure

- Elevated PP may indicate more stress on Left ventricle
- PP and Atrial fibrillation are directly connected (Framington Heart study)
- For every increase of 10 mm there was a 12% increase in Atrial fibrillation
"Test of cardiovascular system state" dialogue

The dialogue is designed to perform the test of cardiovascular system state.

Measured Parameters

- **Heart Rate:** 86 b/min
- **Vascular stiffness:** 2.9%
- **Pulse Curve Type:** A:30, B:15, C:55
- **Vascular Aging:** 38 years
- **Stress Index:** 851
- **Oxygen Saturation:** 96.6%

Sensor Signal Parameters

- **Pulse Index:** 1.49
- **Signal Level:** 92.1

Options:

- Details...
- Open conclusion automatically
- Conclusion (view)
- Conclusion (print)

Buttons:

- Restart Test
- Exit
- Help
- Back
- To the Beginning
Before nutrition results:
37% A, 58% B, 5% C

Pulse Curve Type
A:1, B:44, C:55 %
A-type wave is typical for subjects older than 60 years. In persons younger than 60 years, A-type wave may suggest for increased arterial stiffness.
B-type wave is typical for subjects older than 40 years.
C-type wave is typical for younger subjects in the age of 18-35 years with normal elasticity of arterial walls.

Vascular stiffness
-0.5 %
Stiffness index is less than normal values corresponding with good condition of arteries’ walls (16.1%).

Before nutrition vascular stiffness was 6.0%

Vascular Aging
43 years
Good condition of the arteries.

Before nutrition vascular age was 54 years
Recruited for a heavy training session with KAATSU

- Improvements in Pulse Curve Type
- Improvements in Vascular Age
- Improvements in Vascular Stiffness

Bill H. – 62 yrs. old
## Bill H after heavy Kaatsu training  
**Age 62**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Norm</th>
<th>Measured Value</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart Rate</td>
<td>60...90 bpm</td>
<td>74 b/min</td>
<td>Normal pulse rate.</td>
</tr>
<tr>
<td>Vascular stiffness</td>
<td>4.7%...24.7%</td>
<td>13.0%</td>
<td>Stiffness index is normal according to specified age (14.7%). The elasticity of arterial walls is preserved.</td>
</tr>
<tr>
<td>Pulse Curve Type</td>
<td>A</td>
<td>A:79,B:21 %</td>
<td>A-type wave is typical for subjects older than 60 years.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B-type wave is typical for subjects older than 40 years.</td>
</tr>
<tr>
<td>Vascular Aging</td>
<td>56...63</td>
<td>50 years</td>
<td>Good condition of the arteries.</td>
</tr>
<tr>
<td>Stress Index</td>
<td>50...150</td>
<td>139</td>
<td>Normal value. Optimal work of cardiovascular regulatory centers.</td>
</tr>
<tr>
<td>Oxygen Saturation</td>
<td>96...99%</td>
<td>95.7%</td>
<td>This value is typical for patients with cardiovascular and chronic pulmonary disease.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Norm</th>
<th>Measured Value</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart Rate</td>
<td>60...90 bpm</td>
<td>85 b/min</td>
<td>Normal pulse rate.</td>
</tr>
<tr>
<td>Vascular stiffness</td>
<td>4.7%...24.7%</td>
<td>10.5%</td>
<td>Stiffness index is normal according to specified age (14.7%). The elasticity of arterial walls is preserved.</td>
</tr>
<tr>
<td>Pulse Curve Type</td>
<td>A</td>
<td>A:79,B:21 %</td>
<td>A-type wave is typical for subjects older than 60 years.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B-type wave is typical for subjects older than 40 years.</td>
</tr>
<tr>
<td>Vascular Aging</td>
<td>56...63</td>
<td>50 years</td>
<td>Good condition of the arteries.</td>
</tr>
<tr>
<td>Stress Index</td>
<td>50...150</td>
<td>1724</td>
<td>Very high stress index. Suggests the decrease pulse wave variability. Associated with poor prognosis in patient with heart failure, diabetes mellitus and severe arrhythmias.</td>
</tr>
<tr>
<td>Oxygen Saturation</td>
<td>96...99%</td>
<td>88.7%</td>
<td>A significant decrease in oxygen saturation (less than 90%). Is observed in cases of severe respiratory failure or impaired cardiac function.</td>
</tr>
<tr>
<td>Heart rhythm evaluation</td>
<td></td>
<td></td>
<td>In transition the disturbance of the heart rhythm were detected. The electrocardiographic test is recommended.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Norm</th>
<th>Measured Value</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart Rate</td>
<td>60...90 bpm</td>
<td>81 b/min</td>
<td>Normal pulse rate.</td>
</tr>
<tr>
<td>Vascular stiffness</td>
<td>4.7%...24.7%</td>
<td>5.5%</td>
<td>Stiffness index is normal according to specified age (14.7%). The elasticity of arterial walls is preserved.</td>
</tr>
<tr>
<td>Pulse Curve Type</td>
<td>A</td>
<td>A:42,B:46,C:12 %</td>
<td>A-type wave is typical for subjects older than 60 years.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B-type wave is typical for subjects older than 40 years.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C-type wave is typical for younger subjects in the age of 18-35 years with normal elasticity of arterial walls.</td>
</tr>
<tr>
<td>Vascular Aging</td>
<td>56...63</td>
<td>44 years</td>
<td>Good condition of the arteries.</td>
</tr>
<tr>
<td>Stress Index</td>
<td>50...150</td>
<td>606</td>
<td>High stress index. May be associated with high level of social stress and cardiovascular diseases.</td>
</tr>
<tr>
<td>Oxygen Saturation</td>
<td>96...99%</td>
<td>95.8%</td>
<td>This value is typical for patients with cardiovascular and chronic pulmonary disease.</td>
</tr>
</tbody>
</table>
The Body as Sensei

The body is our master teacher.
Ancient traditions understood that all aspects of our physical, mental, emotional and spiritual life form an inseparable unity.

Injure any part and you injure the whole. To heal any part you must heal the whole.
Start with patient education
To give them the *why* behind the total wellness program
Total Wellness Program

1. Give patient information on the importance of AngioScan
2. Run the AngioScan evaluation
3. Give appropriate nutriceutical remedies with instruction to improve endothelium and improve vascular stiffness
4. Set patient up on specific Kaatsu training
5. Recheck AngioScan monthly
Chronic Stress: Burnout & Beyond

The Healthy Stress Response

Effects of High Cortisol/DHEA Ratio
- Increases blood lipids (cholesterol, triglycerides)
- Increases fat accumulation (especially at waist)
- Increases fluid retention
- Increases protein breakdown

The Bottom Line:
Increased allergies, lowers resistance to infections (fungal, viral, bacterial), poor glucose utilization, osteoporotic tendencies, hyperlipidemia, obesity, loss of lean muscle mass and edema

The Bottom Line:
TOTAL BURNOUT
Total Wellness Stress Reduction Program

1. Measure AngioScan. If stress is a factor go to step 2.

2. Customized breathing program to increase parasympathetic nervous system function.

3. Kaatsu Training

Additional testing would be heart rate variability to track the adaptive capacity of the ANS.
Affects of Kaatsu on the Stress Index and traditional Heart Rate Variability
Towards Health

Further studies are needed but, from my short study, the Kaatsu has major implications in any cardiovascular prevention program due to its effect on vascular age and vascular stiffness. The Kaatsu may also have an effect on reducing stress and improving Heart Rate Variability thus reducing the cardiovascular risk even more.

It seems evident that Kaatsu training should be part of a more comprehensive wellness program including screening with AngioScan and Heart Rate Variability and a targeted Nutritional program with modifications in life style.

If you have further questions you can call Dr. Kessler at 415-646-6112 or e-mail drmkessler@sbcglobal.net
Presentation 7
Lyle Nalli, DPM
Davita HealthCare Partners
Presentation 8
KAATSU Specialist Training
Drs. Yoshiaki Sato and James Stray-Gundersen
Panel Discussions
KAATSU In Sports
KAATSU In Medicine
KAATSU In Therapy
KAATSU Global Users
KAATSU for Female Baby Boomers
KAATSU for Female Baby Boomers
KAATSU for Male Baby Boomers
KAATSU for Male Baby Boomers
KAATSU Color and the Distension of Veins
KAATSU Color and the Distension of Veins
KAATSU Strength-building Exercises
KAATSU Strength-building Exercises
KAATSU Cycle for Warm-up, Cool-down, Rehabilitation
KAATSU Cycle for Warm-up, Cool-down, Rehabilitation
KAATSU Core Exercises
KAATSU Core Exercises
Going to Failure
Going to Failure
KAATSU Equipment
KAATSU Equipment