

OSTEOSTRONG AUSTRALIA & NEW ZEALAND **BACKGROUND & RESEARCH**

1. Background to OsteoStrong

The Spectrum equipment used at all OsteoStrong Centres was developed by Dr John Jaquish to help his mother, who was diagnosed with Osteoporosis in her 70's. Using the osteogenic loading prototype BioDensity Machine, John's mother was able to reverse her Osteoporosis in 3 years and today has a T Score of 0. She has not taken any medications or engaged in any other exercise modalities during this time.

Dr. Jaquish's research examined people with very high bone density, confirming that high impact events create strong bones. Gymnasts were in the group with the highest bone density, but these athletes also have very high hip and knee injury rates and retire at a young age. The high impacts events that gymnasts absorb were not practical to implement for all ages and levels of fitness, so Dr. Jaquish invented equipment that would emulate high impacts in a slow, controlled and highly safe and measurable way.

OsteoStrong sessions utilise four robotic musculoskeletal treatment devices called Spectrum invented by Dr. Jaquish that provide for self-imposed axial compression of bone, emulating the effect of high impact. Because of the robotic optimised positioning of the human body, loading forces go through bones far higher than those seen in daily activity or exercise.

High impact training (heavy loading of bones) and strength or resistance training is already understood and recommended by all international bodies to improve bone health.

At OsteoStrong we have simply commercialised this science in a very convenient, safe and highly measurable way that is accessible to most people of all ages and levels of activity.

We currently have more than 35,000 members Worldwide using OsteoStrong Centres with more than 600,000 recorded exercise sessions.

2. Wolff's Law

Dr. Jaquish's Spectrum machines have enabled OsteoStrong Centres to commercialise the widely accepted science of osteogenic loading that is still taught worldwide to Doctors, called Wolff's Law. Using the Spectrum machines, bone Mechanotransduction triggers osteogenesis, which for many people improves bone density.

There have been more than 25,000 peer reviewed studies which support the principles of osteogenic loading for bone growth based on Wolff's Law.

Wolff's Law established more than 120 years ago, teaches us that our central nervous system adapts our skeletal strength in direct response to the loads that we apply to it. Simply explained, the more load we apply to our bones, the stronger they become.

3. Peer Reviewed Studies

3.1 2012 UK Study by Deer & Tobias et al.

In this study, 724 participants were fitted with accelerometers to measure impact on their hips and femur. During exercise sessions, those who experienced impacts of 4.2 multiples of their body weight or more triggered Osteogenesis increased their bone density in hip and femur. Those who experienced below 4.2 MOB did not increase their bone density.

As a result of this important independent study, we now understand that Mechanotransduction (axial bone loading) has a minimum dose response of 4.2 MOB for hip and femur.

Using Spectrum equipment at OsteoStrong Centres, we can safely apply loads of 5 to 15 multiples of body weight, triggering bone osteogenesis in a very safe, slow, controlled, and measurable way, for most people of all ages and physical condition.

This is important, because it has been demonstrated that conventional resistance exercise provides less than 3 multiples of body weight, which does not trigger osteogenesis in the hip and femur. Conventional exercise such as walking, jogging, aerobics, and box jumps provide less than 3.0 MOB and therefore we know that these do not trigger osteogenesis in the hip.

Alternatively, we know that heavy resistance training does positively affect bone density, however using heavy weights can be very dangerous, is unsuitable for many older and very deconditioned people and the results are very difficult to measure and monitor. Another interesting fact is that some un-loaded exercises like cycling and swimming can have negative consequences to bone health.

Our central nervous system also uses neural inhibition to protect the skeleton from fracture, by preventing our muscle strength from exceeding our skeletal strength. This means our muscles naturally become weaker as we age, which significantly affects posture and balance – this is now called Dynapenia (reduced muscle strength) as opposed to Sarcopenia which reduces muscle mass as we age.

For most people, OsteoStrong sessions increase the strength of the skeleton, which overcomes this neural inhibition, enabling an increase in the strength of the whole musculoskeletal kinetic chain. This strength increase improves posture, agility and muscle strength which is very important to fall prevention. Exercise is recognised as important to reduce the rate of falls in older people by 21% and “exercise programs that challenge balance... have a larger effect”.

(Exercise to prevent falls in older adults: an updated systemic review and meta-analysis, C. Sherrington et.al. 2016).

Approximately 10%-20% of people doing regular OsteoStrong sessions do not improve bone density due to existing physiological conditions. Hyperthyroidism, Vitamin D deficiency and Hypocalcaemia are just several examples of physiological conditions which prevent normal bone growth response to osteogenesis.

At OsteoStrong we can detect these cases usually within 6-12 months using base line and follow up testing. In these cases, members are recommended to seek medical advice and treatment, following which they can resume OsteoStrong sessions and then they usually obtain the normal benefits of osteogenic loading.

Even though this initially delays a member’s bone health recovery, it enables early detection and resolution of the other physiological condition that may have had wider health

ramifications in the long term. Plus, the member's strength and balance are improved, reducing their fall potential in the interim which is a desirable outcome.

<https://www.ncbi.nlm.nih.gov/m/pubmed/22492557/>

3.2 2013 US Study Jaquish, International Osteoporosis Foundation, National Osteoporosis Foundation of the USA

Subjects increased hip bone density by an average of 7.0 percent, and spinal bone density by 7.7 percent, after using BioDensity for one year on average. This BioDensity study, conducted between 2011 and 2013 and included DEXA scans for 14 randomly selected individuals, from a total population of 126 patients at five clinical locations. The mean age among the 11 women and three men in the study was 62.5 years.

<https://www.researchgate.net> › 2617...(PDF) Multiple-of-bodyweight axial bone loading using novel exercise intervention ...

<https://www.prnewswire.com/news-releases/use-of-exercise-system-shown-to-build-bone-mass-and-reverse-effects-of-osteoporosis-23>

3.3 2014 US Study by Jaquish & University of Wyoming 1,685 males and 2,689 females showing the safety and efficacy of once a week osteogenic loading sessions

The Biodensity Machine is the first osteogenic loading equipment designed by Dr. John Jaquish in the US. In 2014 a large study was conducted at the University of Wyoming. The purpose of the study was to examine the efficacy and safety of applying multiples of body weight in short 1 repetition exercises on 4 muscle groups once per week for a large population cohort. The study concluded that it was effective and safe method of applying Osteogenic loading based on the principles of Wolff's Law.

<https://www.omicsonline.org/pdfdownload.php?download=open-access-pdfs/biodensity-a-novel-resistance-training-approach-and-learning-effects-in-males-and-females-2165-7025-215.pdf&aid=28505>

3.4 2015 UK Study by Hunte et al

A 24-week UK study of 55 post-menopausal women aged 69 years old \pm 8.3 years in 2015, using osteogenic loading therapy with OsteoStrong equipment, showed an average increase in BMD of 14.9% at the hip and 16.6% in the Lumbar Spine over a 6-month test period.

In the earlier studies, participants were not reassured by the high safety record of any previous studies. In this latter study participants were informed that no injuries had occurred in the 2013/14 studies and that the individual results depended heavily on the individual's commitment to the activity.

With the psychological confidence of the US Studies, which produced a zero injury rate, participants were encouraged to push/pull/lift harder to reach minimum weight targets in

this UK Study. On the Lower GT position participants were encouraged to reach a minimum of 4.2 multiples of body weight based on the UK 2012 Deere Study. There were no injuries during this 2015 study.

<https://www.longdom.org/open-access/axial-bone-osteogenic-loadingtype-resistance-therapy-showing-bmd-andfunctional-bone-performance-musculoskeletal-adaptation-over-24-weeks-withpostmenopausal-female-subjects-2329-9509-1000146.pdf>

4. Is OsteoStrong Suitable For Everyone

OsteoStrong sessions are suitable for most people between 10 and 95 years old at most levels of fitness. The robotic musculoskeletal machines require participants to be of a minimum body size to ensure optimal biomechanical loading of upper and lower limbs. Generally, children under 10 years old do not reach the minimum size requirement, although some 8-year old's are tall enough.

However, OsteoStrong is contraindicated for some people. Contraindications of Spectrum include acute joint pain, unmedicated hypertension, muscular dystrophy (Doctor determination – recent studies have shown benefits from exercise sessions), active hernia (can obtain medical clearance for high intensity exercise) and third trimester pregnancy.

Our regenerative technologies also have a number of contraindications that are screened for as part of our pre-screening process upon commencement of the program.

OsteoStrong always recommends that members obtain exercise clearance from their Doctor before commencing at OsteoStrong and to always have regular check-ups.

5. 2017 Bone Density Research Meta-Analysis by Jaquish et al.

In the graph below, we show change in BMD based on a meta-analysis of 152 peer reviewed studies. The OsteoStrong study was over a 6-month period. The other studies were over 12 months and showed less efficacy by comparison.

The graph shows that OsteoStrong sessions were more than double the efficacy of other medical, supplement, dietary and conventional exercise programs for improving bone density. No supplements were taken by those involved in the OsteoStrong study.

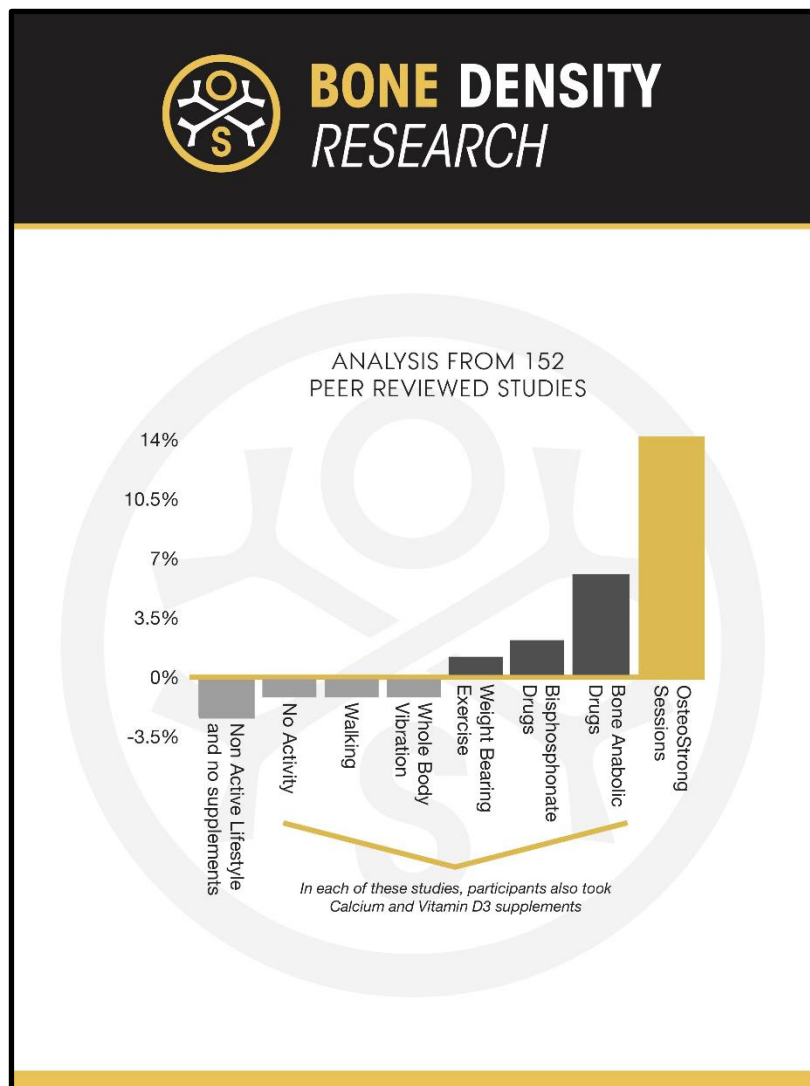
Supplements of Calcium and D3 were taken by participants involved in the other medication and exercise studies.

This was a mono study comparing current treatments for osteoporosis with different exercises of varying MOB levels.



BONE DENSITY RESEARCH

Change in
Bone Density
measured by
DEXA



6. 2017 Strength & Balance Studies by Jaquish et al

Fall potential is exacerbated by a reduction in balance and strength due to ageing, illness and injury.

Erika Y. Ishigaki, et al. conducted a systematic review of clinical trials from 2002 to 2012 (Effectiveness of muscle strengthening and description of protocols for preventing falls in the elderly: a systematic review) and reported that there was "little doubt regarding the effectiveness of lower limb strengthening exercises for preventing falls in elderly subjects".

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4183251/>

A 2017 study by Jaquish et al showed an average increase in musculoskeletal strength of 290% over 3 years as shown in the graph below;

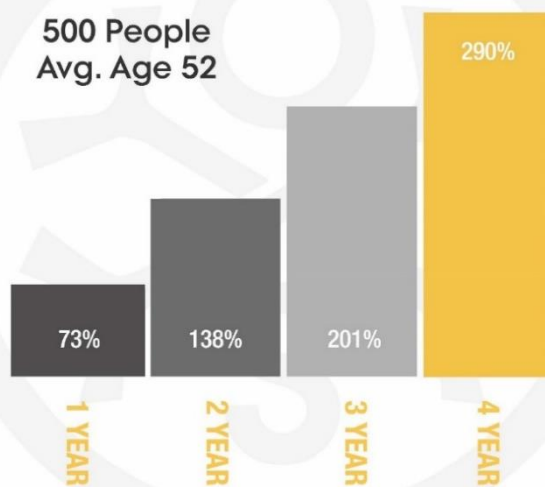


STRENGTH GAIN CASE STUDY

Strength
Increase

7 MINUTES
ONCE A WEEK

500 People
Avg. Age 52



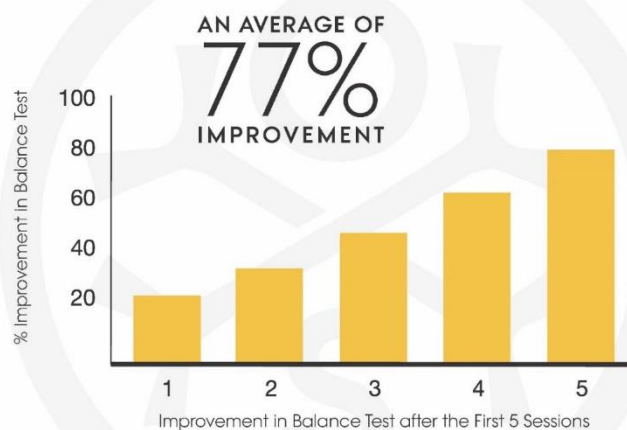
It is also widely accepted that exercise neuro plasticity can result in the growth of new neural pathways. Immediately after significant osteogenic loading events at OsteoStrong, the central nervous system is highly excited for a short time and muscles, nerve synapses and fibres are highly receptive to training & re-education. We refer to this as hyper-neuroplasticity.

At OsteoStrong we undertake neuro-priming before osteogenic loading, followed by intensive brain/balance training immediately after osteogenic loading, taking advantage of this brief period of hyper-neuroplasticity. This training provides accelerated balance improvements because we can speed up the brains natural ability to generate and optimise new neural pathways.

Neurostimulation is achieved using whole body vibration with specific balance training exercises. Our 2017 Balance Study by Jaquish et.al. showed very fast improvements in balance, with an average 77% improvement in just 5 weeks. We use the BTracks Balance Tracking System to test and record balance at OsteoStrong.



BALANCE CASE REPORT



7. Tendons, Ligaments and Joints – Joint & Back Pain & Posture

The high compressive loads applied during OsteoStrong sessions have been observed to support stronger joint strength due to adaptations of tendons, ligaments and muscles surrounding joint capsules. Our observations and member testimonials, show that this adaptation also increases agility and balance, significantly reducing fall potential and may reduce joint pain, particularly for older and deconditioned people.

When articular cartilage is compressed during osteogenic loading, synovial fluid is pushed out and into the joint, where the fluid can lubricate the opposing surfaces. Similarly, synovial fluid acts as a shock absorber. Forces impacting the joints are spread across the synovial fluid, lessening stress on the articular surfaces.

Another important function of synovial fluid is to exchange wastes and nutrients with the surrounding capillaries. This allows for proper maintenance and strengthening of all the joint tissues.

With more supported joints and increased joint lubrication, most OsteoStrong Members report a significant reduction in pre-existing joint and back pain in as little as 3-5 weeks.

In addition, stronger muscles, tendons, ligaments and joints result in significant postural improvements

These observations are supported by the Benjamin & Ralphs Study, Fibrocartilage in tendons and ligaments—an adaptation to compressive load. Anatomy Unit, Cardiff School of Biosciences, Cardiff University, Cardiff, UK. 1998.

<file:///C:/Users/perrye/AppData/Local/Microsoft/Windows/INetCache/Content.Outlook/4AXUSFUM/Fibrocartilage%20in%20tendons%20and%20ligamentsan%20adaptation%20to%20compressive%20load.pdf>

8. Diabetes Type 2

Diabetes Type 2 is a metabolic dysfunction disease. The adaptation of muscles resulting from high osteogenic loading is called myofibril hypertrophy, which over time increases muscle cell density. Theoretically this adaptation should restore muscle metabolic function.

To test this theory a Pilot Study was undertaken in 2015 by Hunte et.al. and the UK National Health Service, titled “The Effects of Axial Bone Osteogenic Loading-Type Resistance Exercise on Adults with Risk of Moderate-Metabolic Dysfunction”

The purpose of the Study was to determine the efficacy of osteogenic loading (OsteoStrong sessions) on glycaemic control in older adults with pre-type 2 diabetes. In the 24-week observational trial, 21 adults completed twenty-four weeks of osteogenic loading therapy (sessions one time per week). Pre-diabetic adults were tested, because ethics approval to test unmedicated people with diagnosed Diabetes Type would not have been approved.

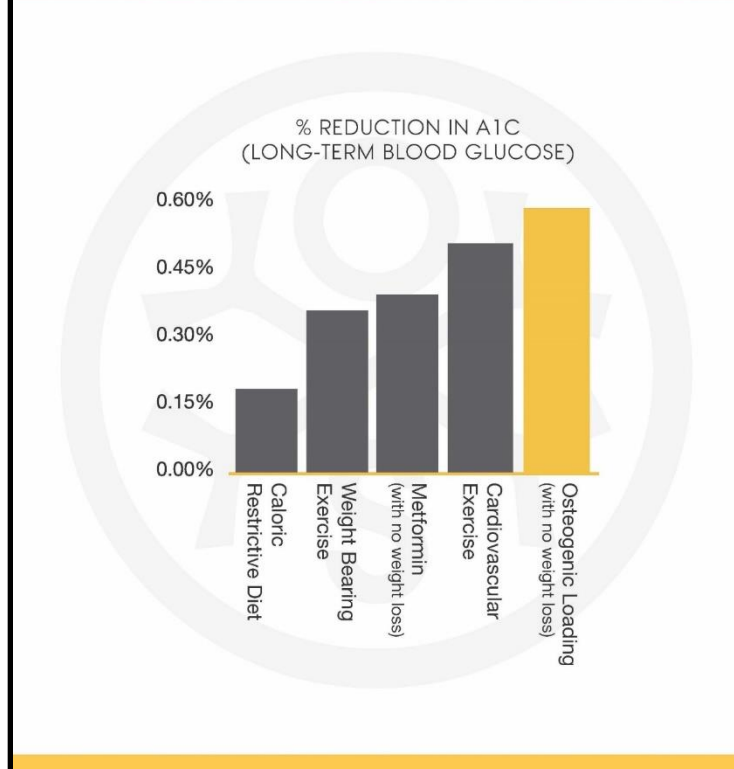
The conclusion of this Study was that osteogenic loading therapy as a supplement to standard care is both feasible and effective in improving glycaemic control among moderate-risk adults with poor glycaemic control.

Significant reductions were measured in HbA1c levels amongst group subjects by 8.8% (+/- 4.1% SD) from baseline to post-test without weight or BMI change.

Subsequently, many OsteoStrong members have reported reversing and eliminating Type 2 Diabetes using osteogenic loading alone and in combination with other treatments.



TYPE 2 DIABETES RESEARCH



9.0 Slow-Start Program for Older Deconditioned People

In all ANZ OsteoStrong Centres we are implementing a Slow Start Program for older deconditioned people and those with osteoporosis and previous fragility fractures. The importance of bone health exercise programs for these people is critical.

The accessibility and safe delivery of these programs widely, and the ability to measure and record results, is very difficult with conventional training programs offered at gyms.

The Slow Start Program is essentially based on the SuperSlow Program developed by Ken Hutchins of Orlando Florida, Fitness Research Director at South Shore YMCA, for dealing with women with osteoporosis.

OsteoStrong sessions are very safe – with more than 35,000 members Worldwide and over 600,000 recorded OsteoStrong sessions. Nonetheless it is a physical modality and muscle and joint issues can result unless carefully managed, which is the principle reason all sessions are fully supervised on a 1:1 basis with clients. Minor injury rates involving muscle strains and soreness are reported as below 1:4000 people.

Session coaches are trained by OsteoStrong, including an on-line USA based training course, followed by hands on training at our ANZ training Centre in Hawthorn.

All coaches must be qualified before being certified by OsteoStrong ANZ to work in Australia or New Zealand. In addition, all ANZ Centres will include a minimum of one qualified exercise/sports training qualified person.

We provide extensive pre-session screening for all members involving a comprehensive wellness assessment and health history form designed to identify any issues that may affect their physiological performance. As well as ongoing consultations, 3 monthly to assess for functional performance, adaptations and improvements to our members health and wellbeing.

OsteoStrong sessions may be claimed via private health under the general wellbeing category by submitting your receipts directly with the members fund.

10.0 OsteoStrong Is A Natural Medicine - Exercise

As a completely natural medicine (exercise), osteogenic loading theoretically supports natural bone formation and bone health. Both osteoclast and osteoblast activity are supported.

This is significant because new research by A.Grüneboom suggests that in addition to reabsorption of old brittle bone, which is recognised as important to bone health, osteoclast activity is very important to blood and immune health. (Anika Grüneboom 2019 Study - A network of trans-cortical capillaries as mainstay for blood circulation in long bones).

11.0 Organisations Supporting Osteogenic Loading Principles

In 2009 the US Surgeon General supported the principle of osteogenic loading for bone health.

American Bone Health has supported osteogenic loading as a physical medicine for improving bone health for nearly a decade.

(<https://americanbonehealth.org/exercise/bonesense-on-osteogenic-loading/>)

The International Osteoporosis Federation has supported OsteoStrong at international events - Dr John Jaquish has been a presenter at several IOF Conferences including Sydney 2018 and Milan 2015.

The head of the Osteoporosis Department Dr. Alkassir at the Danderyd Hospital in Stockholm, Sweden refers osteoporosis patients to OsteoStrong, particularly if they do not wish to take OP medications.

Importantly, the American College of Sports Medicine has confirmed that the human body is more than 7 times stronger in its strongest range of motion. This confirms that in the correct biomechanical position high loads can be applied with a high degree of safety. This is what the Spectrum machines do at OsteoStrong. They allow impact high impact loading in a slow, safe, controlled and measurable way.

(<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4139760/>)

12.0 Adherence To An Exercise Program for Bone Health

One of the biggest problems of any commercial exercise program is the aspect of program adherence and participation.

Unfortunately, most people do not engage in exercise programs with adequate regularity to make a significant difference – lack of time, family obligations, tiredness, lack of willpower, determination or confidence, effort, travel, sweat, cost and lack of biofeedback and rewards, all defeat people's resolve to either start or maintain an exercise program.

It is also recognised that load related pain is a significant barrier to older people starting or maintaining any exercise program, and that overcoming this substantial barrier is important for both lifespan and healthspan.

It is accepted industry knowledge that about 85% of conventional gym members do not renew memberships at the 1st anniversary and only about 25% attend regularly more than once per week. Because the typical age of group with the highest participation rate is 18-34, this means that only 4-5% of the total population actively benefit from gym memberships.

Those over 50 who are in the highest group affected by osteoporosis are in the lowest gym membership participation rate group. This is relevant, because the ratio of people in this group is increasing, while the ratio of people in the highest gym usage group is declining due to our ageing population. In stark contrast, OsteoStrong records overseas show that almost 100% of OsteoStrong members attend every week, and more than 90% renew their memberships annually.

In addition, approximately 2/3rds of OsteoStrong members overseas are in the needs based over 50's age group, which is also the highest needs group for osteoporosis.

OsteoStrong's high adherence rate, wide age group applicability and very positive results, show that OsteoStrong is a highly effective exercise program for improving community bone health.