Diabetes

Definitions

- Type 2
  - Commonly known as adult onset diabetes or non-insulin dependent diabetes mellitus (NIDDM).
  - Usually affects people over the age of 30.
  - The pancreas does not produce enough insulin or the body does not use the insulin that is produced effectively often as a result of receptor and cell sensitivities to insulin being reduced.
  - As a result, blood glucose level becomes elevated. In many cases, proper diabetic diet, weight management and regular exercise can control type 2. However, medication and insulin are often required.

Diabetes, Exercise and Ageing

- Diabetes mellitus is characterized as a metabolic disease that is caused by a deficiency in insulin secretion or the inability to use insulin properly, which results in high blood glucose levels.

Dr. Banting

Definitions

- Gestational diabetes
  - Temporary condition that occurs during pregnancy and results in an increased risk of developing diabetes for both mother and child. It affects two to four percent of all pregnancies and is generally treated with dietary measures.

Definitions

- Type 1
  - Commonly known as juvenile onset diabetes or insulin dependent diabetes mellitus (IDDM).
  - The individual's own immune system attacks the beta cells of the pancreas that are responsible for the production of insulin and as a result, the pancreas is no longer able to produce insulin.
  - This results in elevated blood glucose levels, as insulin is the hormone that is responsible for transporting the glucose in the blood to the body tissues.
  - Thus, the individual must administer regular insulin injections in order to manage their blood sugar levels effectively.
  - Approximately 10% of people with diabetes have type 1.

Symptoms

- Type 1
  - Frequent urination, unusual thirst, extreme hunger, unusual weight loss, extreme fatigue, irritability, nausea, vomiting and sweet smelling breath.
- Type 2
  - Frequent infections, cuts and bruises that are slow to heal, tingling/numbness in the hands or feet, recurring skin, gum or bladder infections, frequent urination, unusual thirst, extreme hunger, unusual weight loss, extreme fatigue, irritability, nausea, vomiting and sweet smelling breath.

Risk Factors

- Type I
  - race/ethnicity (diabetes is more prevalent in people of Aboriginal, African and Latin- American descent)
  - family history of diabetes.
- Type II
  - age (over 45 years old)
  - obesity (the number of people with diabetes in an unhealthy weight range is double that found in the population without diabetes)
  - gave birth to a large baby (over 4.0 kg/ 9 lbs)
  - previous diagnosis of impaired glucose tolerance.

Diabetes and Ageing

- Ageing is associated with the development of impaired glucose tolerance. Type 2 diabetes is very common in adults over the age of 65. It is an unknown whether impaired glucose tolerance is a primary effect of ageing or of other age- related changes such as increased body fat, decreased muscle mass, and decreased physical activity. It is known that regular exercise can help reverse the usual decrease in insulin sensitivity normally associated with ageing. The person with diabetes is susceptible to atherosclerosis, small blood vessel and nerve damage and infection.

Diagnosis

- Fasting Plasma Blood Glucose
  - Impaired fasting glucose: 6.1-6.9 mmol/L
  - Diabetic: 7 + mmol/L
- Oral Glucose Tolerance (Primarily used for post-partum testing and research)
  - Test of the body's ability to metabolize carbohydrate. It is performed by giving a standard dose of glucose and measuring the blood and urine for glucose at regular intervals.
  - Diabetic: plasma blood glucose ≥ 11.1 mmol/L two hours after a 75-g glucose load

Diabetes and Nutrition

- One of the most important tools in treatment of diabetes is nutrition. The primary goals for diabetics are to monitor their energy intake, maintain a healthy weight (often there is a great need for weight loss), and control blood glucose levels. By decreasing the body weight to an acceptable level, insulin sensitivity is improved. Meal planning follows the "diabetic exchange system" and the "Canada food guide to healthy eating". It is important for diabetics to closely monitor the intake of carbohydrates as this is the macronutrient that has the greatest effect on the blood glucose level (carbohydrates break down into sugars). There are two types of carbohydrates: starches and sugars. Starches include cereals, bread, pasta and many vegetables. Sugars include: candy, fruits, most juices, pastries, cakes and cookies. The "exchange system" is a plan that allows for a specific amount of carbohydrates in measured serving sizes throughout the day in order to ensure stable blood sugar levels.

Common Medication

Medication (pills commonly prescribed in Type II)	**Action**
Sulfonylureas (Diabeta, Diabinese, Diamicron)	These stimulate the pancreas to produce more insulin. When taking these pills, it is very important to eat three regular meals a day.
Biguandies (Glucophage)	These help your body use sugar more efficiently.
Acarbose (Prandase)	This type prolongs the absorption of carbohydrate after a meal. You must eat for these pills to work.
Thiazolidinediones (Actos, Avandia)	These control blood glucose by making the muscle cells more sensitive to insulin.

Glucose Transport

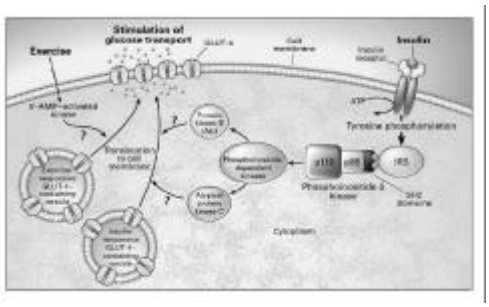
- Glucose is taken into the muscle cell by means of a transport system. This transport system is triggered when the muscles are exposed to insulin or if the muscles contract.

Glucose Transport

- When glucose is in the bloodstream it requires insulin and a transporter to move into the cell and be utilized. This transporter is called GLUT-4. Once the insulin and insulin receptor complex are formed, the glucose transporter proteins (GLUT-4) carry the glucose into the muscle cell.
- When a muscle is exercising, more of the GLUT-4 transporters are brought to the surface of the cell and the transporters are also working more efficiently and thus more glucose can be brought into the cell at this time.

Exercise Benefits

- Glucose control
  - A major focus in any diabetes management plan is to ensure that the blood glucose levels are in control. Exercise which is regular and of sufficient duration and intensity can positively impact glucose levels. It is important to ensure that the levels are monitored regularly to protect against a drop in blood glucose, known as hypoglycaemia. Hypoglycaemia can occur when the glucose level in the blood falls due to the increased energy demand that is placed on the body during exercise. Blood glucose testing and sufficient carbohydrate intake prior to activity can aid in the prevention of hypoglycaemia.



Exercise Benefits

- Signs of hypoglycaemia
  - The warning signs of hypoglycaemia include: shakiness, dizziness, light-headed, sweaty, uncontrollable hunger, blurred vision, mood change, irritability, fatigue, irrational and unclear thinking, pounding heart, headache, nervousness, anxiousness.
  - Causes of hypoglycaemia include: late or missed meals, exercise without monitoring blood glucose and controlling with food, too much medication or insulin, illness or stress.
  - The best treatment of hypoglycaemia is to administer fast acting carbohydrates (sugar). Orange juice, candy, sugared soda, raisins, and fruit punches are some good examples.

Exercise Benefits

- The role of exercise is often not emphasized enough in the treatment of diabetes. Regular activity can significantly lower the likelihood of obesity along with improving body composition (decreasing body fat). Regular exercise has many additional physical benefits including cardiovascular conditioning, decreased blood pressure, improved lipid profile (more HDL, less LDL, lower cholesterol level) and an increased effect of insulin. The beneficial effects of insulin include increased insulin sensitivity, increased insulin action and increased insulin binding. These are due to a combination of the acute effect of exercise and of short-lived adaptations. Therefore, diabetic patients must maintain a physically active lifestyle in order to preserve the acquired benefits.

Exercise Benefits

- Signs of hyperglycaemia
  - The majority of complications that are associated with diabetes occur as a result of high blood glucose levels and their impact on the body. Some of the signs that a diabetic may be in a hyperglycaemic state include: frequent urination, extreme thirst, fatigue, irritability, blurred vision, and sweet smelling breath.
  - Causes of hyperglycaemia include: excess food (especially carbohydrates), less exercise, forgetting medication, illness, and unusual stress.
  - Treatment: the blood glucose level should be tested to give an accurate reading and insulin or medication should be administered.

Complications

- MICROVASCULAR (small blood vessel damage)
  - Retinopathy- impairment or loss of vision due to blood vessel damage in the eyes. Retinopathy is the sole cause of blindness in 86 % of type 1 diabetics and 33 % of type 2 diabetics. Of all new cases of adult blindness, 12 % are caused by diabetes.
  - Neuropathy- nerve damage and foot problems due to blood vessel damage to the nervous system. 40 to 50 % of people with diabetes are affected by neuropathy. Lower extremity amputation is 11 times more frequent for people with diabetes than people without diabetes.
  - Nephropathy- kidney disease due to blood vessel damage in the kidneys. 12 % of seniors with diabetes suffer from kidney disease. Nephropathy is a major cause of illness and early death for people with diabetes. Nephropathy is the number one cause of end-stage renal failure in Canada.

Arthritis

Complications

- MACROVASCULAR: (large blood vessel damage)
  - Cardiac Problems - the risk of cardiac heart disease and stroke is increased by two-fold in men and three to four-fold in women.
  - Hypertension (high blood pressure) - seniors with diabetes are twice as likely to develop hypertension than those without diabetes.

Arthritis In Canada

- Arthritis is the leading cause of LT disability in Canada, affecting 1 in 7 Canadians
- The number of people with arthritis in Canada is expected to increase by approximately one million per decade. (from 3.2 million in 1996 to 5 million in 2016)
- The highest incidence of arthritis in Canada is reported in the Maritimes

Complications

- OTHER COMPLICATIONS
  - Infections- diabetics are more susceptible to infections (mouth, gums, urinary tract, lower extremities, incisions after surgery) if blood sugar levels are not monitored and controlled.
  - Impotence- 50 - 60 % of men with diabetes experience impotence.
  - Pregnancy Complications - 4 % of women develop gestational diabetes mellitus (GDM); with an increased risk of developing diabetes later in life for both mother and child.

Arthritis In Canada

- It is predicted that all of the provinces will see an increase in the incidence of arthritis with Ontario and Quebec showing the greatest increases
- Canadians aged 45 and older are expected to experience the greatest increase
- Arthritis costs Canadians $17.8 billion annually

ANKYLOSING SPONDYLITIS

- Ankylosing means fusing together
- Spondylitis is the inflammation of the vertebrae
- A painful, progressive type of rheumatic disease that affects the spinal area in which the joints and bones fuse together
- Usually strikes men between late teens and early twenties

Ankylosing Spondylitis Diagnosis

- Must be diagnosed early and correctly making sure it isn't confused with back pain
- AS patients always have at least 4 out of the 5 symptoms.
  - onset before age 40
  - morning stiffness of the spine
  - improvement with movement
  - subtle onset
  - duration of symptoms longer than 3 months

Ankylosing Spondylitis Symptoms

- Slow or gradual onset of back pain and stiffness over weeks or months rather than hours or days
- Pain may persist down to buttocks and thighs
- Early-morning stiffness and pain, wearing off or reducing during the day with exercise
- Persistence of pain for more than 3 months

Ankylosing Spondylitis Causes

- Not really sure
- All AS patients seem to have a certain gene called the Human Leucocyte Antigen B27 (HLA-B27).
- Having this gene doesn't mean you have AS but your chances do increase (about 20%)
- No conclusive evidence but it seems that the gene must interact with certain unknown proteins in the body and the combination of the two alters the human immune system and causes AS

Ankylosing Spondylitis Symptoms

- Feeling better after exercise and feeling worse after rest
- Weight loss, especially in the early stages
- Fatigue
- Feeling feverish and experiencing night sweats
- Pain and tenderness along back, pelvic bones, sacroiliac joints, chest, heels

Ankylosing Spondylitis Treatments

- No cure
- Proper posture
- NSAIDs
- Exercise and activity

FIBROMYALGIA

- What is it? Widespread pain and tenderness
- Estimated prevalence of 2.1 to 5.7% of the population
- Diagnosis:
  - widespread pain for at least 3 months
  - tenderness in 11 of 18 active tender points

Fibromyalgia Causes

- Of unknown cause
- Some possible factors include:
  - mechanical problems in neck and lower back
  - motor vehicle accidents
  - work related injuries
  - viral illnesses
  - surgery
  - infections
  - emotional traumas
  - physical or emotional stress

Fibromyalgia Signs and Symptoms

- Fatigue and disturbed sleep
- Stiffness and numbness
- Joint or soft tissue swelling
- Dry eyes

Fibromyalgia Treatment

- Medication
- Physical Therapy
- Lifestyle Management
- Prognosis is variable

Fibromyalgia Signs and Symptoms

- Intolerance to cold
- Sensitivity to foods, allergens and medications
- Feeling of weakness
- Poor memory or concentration
- May also be accompanied by depression, tension or migraine headaches, irritable bowel and bladder, chronic fatigue syndrome and temperomandibular joint dysfunction

Rheumatoid Arthritis

- WHAT IS IT?
- Chronic, progressive, systemic disorder
- An inflammatory disease
- Occurs in both sexes – women affected more than men (3:1 ratio) but as age increases this tends to occur equally in both sexes

Rheumatoid Arthritis

- Usually begins in middle age (b/w ages 20 – 50 yrs)
- Tends to occur bilaterally
- May become very debilitating
- Individuals may also experience psychological effects – depression, anxiety, learned helplessness

Rheumatoid Arthritis Causes:

- In RA- there is a defect in the inflammatory process ∴ inflammation continues
- Swelling is due to edema fluid in the joint mainly due to:
  - Entry of leukocytes
  - Proliferation of synoviocytes, blood vessels, and lymphatics

Rheumatoid Arthritis Signs and Symptoms:

- Pain and swelling of joints
- Morning stiffness of joints and muscles
- General weakness and fatigue
- Fever and weight loss
- Tenderness, deformity, limited motion
- Joints affected – commonly affects wrists, ankles, toes
- Other joints affected – elbows, shoulders, feet, ankle, knees, hips

Rheumatoid Arthritis Causes (continued)

- Synoviocytes grow and divide abnormally, causing the synovial membrane to become thicker, tender, more swollen
- 2 types of WBCs – lymphocytes & leukocytes → primary infection fighting units
- In RA:
  - Lymphocytes - 2 subtypes – T cells and B cells
    - T cells mistake the body's own collagen cells as foreign antigens ∴ tries to destroy them
    - this stimulates the B cells to produce antibodies that attack the antigen (body's own cells)

Rheumatoid Arthritis Causes:

- The inflammatory response is a result of the body's immune system
- Normally- during an injury, WBCs get rid of foreign protein and blood cells gather at injured site ∴ get inflammation → this process in controlled

Rheumatoid Arthritis Causes - continued

- Leukocytes
  - stimulated by the over reactive T cells
  - leukocytes in turn stimulate leukotrienes, prostaglandins, and cytokines
  - leukotrienes – attract more WBCs to the area ∴ more cells trying to get rid of foreign protein
  - prostaglandins – open blood vessels and increase blood flow
  - cytokines - ??? – release enzymes(collagenase and cathepsin) which destroy collagen
- In later stages= crippling effects = deterioration of articular cartilage, necrosis, contracture → irreversible

Rheumatoid Arthritis
Factors Leading to RA

- Currently unknown what factors causes the inflammatory process (only hypothesis)
  - 1) HLA-DR4→ molecule that tricks the immune system to attack collagen protein
  - 2) CRH (corticotropin-releasing hormone) – deficient ∴ does not suppress the inflammatory process
  - 3) p53 – gene is defective in RA ∴ cells do not die they continue to reproduce

Osteoarthritis
Incidence and Prevalence

- OA increases in prevalence parallel with age
- By age 70, 85% will have some degree of OA
- Racial patterns have been noted (varying occupations and lifestyles)
- Affects 1 in 10 Canadians

Rheumatoid Arthritis
Treatment:

- Heat – to decrease pain but not inflammation
- Ice – decreases inflammation – method of choice
- Exercise - stretching and strengthening
  - helps improve psychological problems
- Medications – NSAIDs, DMARDs, Corticosteroids
- Surgery – last resort

Osteoarthritis
Signs and Symptoms

- Persistent joint pain and stiffness
- Commonly affects weight bearing joints such as the knees, hip, spine and feet
- The finger joint and base of the thumb are affected as well
- The source of pain is not from cartilage, but due to the altered joint anatomy
- Inflammation, if present, is usually mild
- May hear a grating sound when roughened cartilage rubs together

OSTEOARTHRITIS

- OA is a functional disorder of joints, characterized by altered joint anatomy, especially the loss of articular cartilage
- There are three types of OA
  - Primary
  - Secondary
  - Generalized Primary
- Myths of OA
  - It is an inevitable disease of ageing
  - It is a wear and tear disorder
  - It is an inflammatory disease (implied by the name itis)

Osteoarthritis
Risk Factors

- Excess Weight
- Age
- Heredity
- Injury

Osteoarthritis
Diagnosis of OA

- OA is defined by the changes in joint anatomy as seen on an x-ray which include:
  - Gradual narrowing of joint spaces due to loss of cartilage
  - Thickening of bone ends
  - Development of fluid filled cysts deep in the bone
  - Growth of bony spurs (osteophytes) at the edges of bone joints

Osteoarthritis
Clinical Features

- When cartilage is weak/damaged, the nerve endings on bone sense pain from weight bearing forces
- Excessive forces cause increased blood flow(hyperemia) and lead to further pain
- Due to the erosion of cartilage, bones rub on each other increasing the pain

Osteoarthritis
Diagnosis of OA

- Changes that do not show up on an x-ray include:
  - Cartilage is pitted and cracked with tiny fissures
  - Lining of the joint is thickened and may be inflamed
  - The joint capsule becomes thickened
  - Sinovial fluid increases in volume and water content

Osteoarthritis
Two Pathological Responses

- A) Structural Breakdown of cartilage
- B) Proliferation of new bone
  - Structural breakdown is characterized by:
    - Imbalance between enzymes that strip cartilage and those that build
    - Initially, chondrocytes respond to damage of the collagen frame work by increasing proteoglycan production
    - -this process attracts water, causing cartilage to swell
    - Swelling causes further alterations of the collagen network

Osteoarthritis
Clinical Features

- Pain is caused by tendons, ligaments and muscles contracting in spasm to protect the joint from movement
- Inflammation occurs when eroded cartilage floats in synovial fluid and irritates the synovial membrane

Osteoarthritis
A) Structural Breakdown continued...

- In later stages, the cartilage layer thins and the concentration of proteoglycan decreases compared to water content
  - directly proportionate to the severity of the disease
- Interleukin-1 is a powerful promoter of inflammation capable of inducing chondrocytes and synovial cells to produce MMP's
- MMP's are the primary enzymes responsible for degrading cartilage
- MMP synthesis is greatly accelerated because the inhibitors (TIMP and PAI-1) become overwhelmed, resulting in cartilage degradation

Osteoarthritis
B) Proliferation of New Bone

- Cartilage breakdown is followed by attempts at repair characterized by:
  - Proliferation of new bone and cartilage at the joint periphery leads to spur formation
  - Synthesis of matrix proteoglycan and collagen increases
  - New bone is layed down in replacement of cartilage, but is not as elastic as normal bone
  - Fractures in new bone occur with loading
    - fluid from the joint seeps into the cracks, where it expands into cysts

Osteoarthritis
Specific Joints

- KNEE
  - 20-30% of people over 65 have OA of the knee
  - Women are twice as likely as men to develop OA of the knee
- HIP
  - Obvious cause is birth abnormality, such as congenital dislocation of the hip or one leg being longer than the other
  - Slightly less common form of OA
  - Same rate in women and men

Osteoarthritis
B) Proliferation of New Bone

- Osteophytes develop at the edges of the joint, altering it's contour, impeding movement and causing pain

Osteoarthritis
Specific Joints

- HANDS/FEET
  - Erosion of the joint at the base of the thumb
  - Growth of bony spurs(osteophytes) in the finger tips(Heberden's or Bouchard's nodes) occur in women ten times more often than in men because the genetic disposition is passed from mother to daughter
- SPINE
  - Disks between the vertebrae lose some of their water content
  - Lumbar region is the most common site of OA

Osteoarthritis
Result of Pathological Responses

- When reparative processes fail to keep pace with degenerative change, OA ensues.

Osteoarthritis
Treatment

- Medication
- Heat / Cold
- Protect Your Joints
- Exercise
- Weight Control
- Viscosupplementation
- Surgery

Treatment
Exercise Therapy

- Before beginning it is important to have the approval of your physician or physiotherapist
- Treatment goals for exercise in OA:
  - Reduce Impairment and improve function
    - the aim here is to decrease pain, improve ROM and strength, normalize gait and to allow the individual to perform activities of daily living

Treatment – Exercise Therapy
Goals continued…

- gradually increase the duration of your aerobic workouts – you may choose to start off with many smaller exercise bouts throughout the day (ie. 2 min of continuous activity)
- treat post exercise joint pain or swelling as an overuse injury
- implement self management & strategies for LT maintenance

Treatment – Exercise Therapy
Goals continued…

- Protect Vulnerable Joints From Further Damage
  - the goal here is to stimulate the joint structures to facilitate remodeling and repair
  - facilitated by:
    - Reducing Joint Stress
    - Improving Shock Attenuation
    - Maintaining Active Joint Motion & Alignment

Treatment – Exercise Therapy
Initiation Issues

- The most common reasons for not exercising include:
  - pain and stiffness
  - lack of belief of its effectiveness
  - patients lack of self efficacy with respect to exercise
- Encouragement by the health care provider is very important with respect to initiation and maintenance of an exercise program (verbal or written)

Treatment – Exercise Therapy
Goals continued…

- Exercise To Prevent Disability & Improve verall Health Status
  - when starting an exercise program it is important to encourage the patient to:
    - prepare for an aerobic conditioning program by performing flexibility, strength and neuromuscular exercises
  - if there is joint pain, begin with non-weight bearing or partial weight bearing aerobic exercise; progress to weight bearing exercise when it is safe to do so

Drug Therapy
-NSAIDs & New COX-2 Inhibitors

- Traditional NSAIDs (ASA, Ibuprofen) used to treat less serious pain. (Stomach irritation: Gastrointestinal Bleeding, Ulcers)
- COX-2 inhibitors: A new form of anti-inflammatory drug which cause much fewer serious GI side-effects than traditional NSAIDs.
- COX-2 drugs: fastest selling drugs in Canada – even faster than Viagra
- Same cost as other NSAIDs

Drug Therapy
NSAIDs & New COX-2 Inhibitors

- The NSAIDs inhibit cyclooxygenase (COX) enzymes which decrease the production of prostaglandins and thromboxane
- It was originally thought that COX was a single entity
- COX-1 produces protective prostaglandins which maintain GI mucosa and thromboxane which promotes platelet aggregation

Drug Therapy
Benefits of COX-2 Inhibitors

- Rofecoxib reduces the risk of ulcers by 57% vs the traditional NSAID Naproxen
- GI bleeds are reduced by 62%
- Rofecoxib has a documented 75% reduction of endoscopically detected ulcers

Drug Therapy
NSAIDs & New COX-2 Inhibitors

- COX-2 is found primarily in inflamed tissue
- Inhibition of COX-2 provides the anti-inflammatory effects of NSAIDs
- The development of COX-2 selective inhibitors provide the anti-inflammatory effects of NSAIDs without GI and platelet complications

Drug Therapy
Do Not Take COX-2 Inhibitors if…

- Celecoxib and Rofecoxib should not be taken by patients with asthma or kidney problems
- Patients who expirience allergic reactions from ASA or other NSAIDs: Structural similarity exists between all agents
- People with: Ulcers, kidney disease, liver disease or pregnant

Drug Therapy
Benefits of COX-2 Inhibitors

- Celecoxib and Rofecoxib are the 2 main COX-2 inhibitor drugs
- Experimentally proven equally effective as traditional NSAIDs as an anti-inflammatory agent
- GI side-effects comparable to placebo group
- Half life of Rofecoxib is 17 hrs vs 11 hrs for Celecoxib: Suitable for single daily dosing

Drug Therapy
Side Effects of COX-2 Inhibitors…

- Upper Respiratory Tract infection, diarrhea, nausea, headache and heartburn
- If unexpected weakness, vomited blood or black/bloody stool encountered –May have stomach ulceration and bleeding

Alternative Treatments

- Please consult a doctor before trying any alternative treatment
- Alternative treatments are not 100% effective and may not work for everyone
- There is not a lot of scientific data to back up the claims of alternative treatments
- Over $1 billion (US) spent on alternative treatments each year

Alternative Treatments Herbal Remedies

- Ginger may relieve arthritic symptoms
- Alfalfa contains minerals for bone formation
- Primrose oil may have anti-inflammatory effects

Alternative Treatments Diet and Nutrition

- Eating a healthy diet
- Juice therapy
- Eating cold-water fish such as mackerel, herring, sardines and salmon is believed to help arthritis because of anti-inflammatory characteristics
- Cod liver oil has the same effects

Alternative Treatments Treatments

- Chiropractics
- Acupuncture
- Bodywork

Alternative Treatments Nutritional Supplements

- Vitamin C, A, B1, B6, E are all anti-inflammatory drugs
- Glucosamine Sulphate is a highly used drug.It is a natural product of the body and it slows the degradation of cartilage and connective tissues, helps repair eroded or damaged tissue by stimulating growth and it gives cartilage it's strength and rigidity
- Chondroitin Sulphate is also found in the body as part of the synovial fluid. It decreases degeneration, improves joint function and eases pain

Interesting Facts Advances in RA Treatment

- Monoclonal antibodies which specifically target B lymphocytes & temporarily destroy them.
- When new B lymphocytes form, they will not attack the cartilage. (Rebooting a computer)
- The rest of the immune system (T cells and antibodies) continue to work: Subjects not susceptible to infection during this period.
  - 6 out of 10 ➔No more arthritis.
  - 9 out of 10 ➔Useful improvement.

Connective Tissue, Bone, Osteoporosis and Exercise

Mechanism of Primary Bone Loss

- Calcium Deficiency -Induced Bone Loss
  - Many women in our society have a calcium deficient diet due to weight-consciousness, preoccupation with fat content in the diet, intolerance (physiological or psychosocial) to dairy products, or confusing information from "health professionals" regarding the relative merits/dangers of dairy products. Supplementing the diet with calcium can prevent calcium deficiency-induced bone loss. It cannot, however, prevent hormone deficiency, induced bone loss which occurs at the menopause.

Mechanism of Primary Bone Loss

- Ageing Bone Loss
  - Bone loss occurs in both men and women after peak bone mass has been achieved (age 20-35). Development of osteoporosis and fracture due to ageing alone is a function of what the peak bone mass was and the life span. Bone loss is rarely this simple, however, and is usually complicated by other factors such as calcium deficiency, sedentary lifestyle, genetics, hormone deficiency, medications, and other medical conditions which can also affect the skeleton.

Mechanism of Primary Bone Loss

- Exercise Deficiency - Induced Bone Loss.
  - Weight bearing activities produce biomechanical stresses in the bones which direct bone remodelling to make the bone strong in the direction of the stresses imposed upon it. To maintain bone strength, they need continual stimulation of sufficient magnitude to withstand the stress of physical activities in a gravity dependent atmosphere. A sedentary lifestyle, or exercise deficiency, causes bone loss because the skeleton is no longer stimulated to remodel bone in that direction.

Mechanism of Primary Bone Loss

- Calcium Deficiency -Induced Bone Loss
  - Lack of sufficient calcium in the diet will result in bone loss. The skeleton is the largest storehouse of calcium in the body. It is necessary for many biological functions and circulating concentrations of calcium in the bloodstream are tightly regulated. If the diet is deficient in calcium the body will obtain it from the skeleton through bone resorption.

Mechanism of Primary Bone Loss

- Exercise Deficiency - Induced Bone Loss.
  - In a sedentary individual, the bones will be strong enough to withstand stresses imposed upon it in a sitting position or with low loads because that it is what it usually is exposed to. The skeleton will not be strong enough to withstand higher stresses which occur with heavy loading such as lifting (groceries out of the car, a turkey out of the oven, a small grandchild, a large pot off a high shelf, laundry out of the washer), shoveling snow, gardening, opening a resistant window, stepping off a curb, or even simply coughing.

Mechanism of Primary Bone Loss

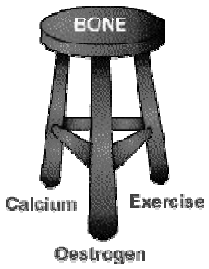
- Exercise Deficiency - Induced Bone Loss.
  - Only weight-bearing exercise based on the overload principle is sufficient to maintain strong bones. Exercise will help to prevent exercise deficiency-induced bone loss but cannot prevent calcium deficiency or hormone deficiency-induced bone loss.

Mechanism of Primary Bone Loss

- Oestregen Deficiency - Induced Bone Loss.
  - Only some form of hormone replacement or SERMs (Selective Oestrogen Receptor Modulators) can impact on this mechanism of bone loss. Dietary calcium supplementation and exercise, cannot prevent or reverse bone loss attributable to hormone deficiency.

Mechanism of Primary Bone Loss

- Oestregen Deficiency - Induced Bone Loss.
  - During our biologically useful, oestrogen-replete adult life, women are protected from many adverse conditions such as heart disease, hypertension, high cholesterol (low circulating concentrations of HDL, high LDL), and bone loss. At menopause, however, oestrogen is no longer produced by the ovaries and we lose its protective effects. HDL and LDL cholesterol levels in the blood are the same as in men and the risk of heart disease is increased.



Mechanism of Primary Bone Loss

- Oestregen Deficiency - Induced Bone Loss.
  - In bone, the rate of bone loss accelerates for 10 to 15 years. After this period bone loss returns to the same rate as in men. It is this accelerated phase of bone loss, combined with a lower average peak bone mass that puts women at higher risk of osteoporosis and fracture than men. Combine that with calcium deficiency, a sedentary lifestyle, and advancing age and you can understand why osteoporosis is so prevalent.

The Role of Exercise

- In a telephone survey women were asked what is most effective at preventing osteoporosis.
- The responses were Calcium 90%, Exercise 90%, Good Posture 85%, BMD test 40%, and Hormone Replacement Therapy 0%. When asked what exercise is best the responses were Walking 49%, Aerobics 6%, Weight Training 6%, Swimming 5%, other or unsure 34%. Of those who exercised, the exercise they did most of the time was walking (75%).
- One of your largest roles will be to educate your clients about the benefits of exercise, its limitations, and what type of exercise is best for them.

The Role of Exercise

- Exercise has many roles in osteoporosis. Exercise:
  - Helps to maximize bone mass.
  - Works synergistically with anabolic therapy to maximize the therapeutic benefit.
  - Prevents bone loss associated with inactivity (exercise deficiency).
  - Helps to maintain strength, balance, flexibility, aerobic fitness and functional capacity.
  - Strengthens postural muscles and reduces fracture risk.
  - In rehabilitation to correct muscle imbalances, reduce pain, and improve mobility and function.

The Role of Exercise

- Running
  - Running is becoming more and more popular. Many people start running in their 40's, even those who could not run when they were younger. Running can be safe for people with osteoporosis as long as it is done under the supervision of a physiotherapist to address muscle imbalance and pain problems immediately as they arise, and to educate the client re: posture and safety. People can start with 5 ten second intervals separated by 5 minute walks, working up through very gradual progression over 5-6 months to running 4-5 5 minute intervals separated by I minute walks. Eventually they can work up to 20 to 30 minute runs. Posture, good footwear, supervised training, immediate physiotherapy for any problems that develop with modification of the program and correction of muscle imbalances, gradual progression, slow gentle pace are the keys to success.

The Role of Exercise

- Walking
  - There is very little evidence to support walking as an activity that will help to build better bones. In fact there are good studies indicating that walking has no effect on bone mass.
  - One good randomized controlled trial (Nelson ME, e, al., A I -y walking program and increased dietary calcium in post menopausal women: effects on bone. Am J Clin Nutr (1991) 53 (5):1304-11) demonstrated that neither exercise nor calcium intake had any effect on lumbar spine (L2-L4) BMD (DPA), distal radius BMD (SPA), or total body calcium.
  - There was a 2% increase in femoral neck BMD in those with high calcium intake (800 mg suppl) and a 1% decrease in the controls. Trabecular BMD in the lumbar spine (Ll-L3) by CT was increased by 0.5% in exercisers and decreased by 7%. Walking may have different effects at different sites.

The Role of Exercise

- Swimming
  - Swimming has no real functionally beneficial effect on bone. Swimming or resistance training in the water will strengthen muscles and may have an effect on bone. The bones may become strong against forces placed upon them in the reduced gravity environment provided by the water, however, functionally they will not necessarily be stronger in a gravity dependent weight bearing position.

The Role of Exercise

- Walking
  - Walking programs are better than inactivity, especially in view of the other benefits to fitness, strength, functional capacity, cardiac health, lipid profile, glucose regulation, and weight. To be effective, however, it has to be based on the overload principle as with any exercise. Walking the dog, with a toddler, shopping, and pushing a stroller don't count (unless it is a proper exercise stroller that will allow the pusher to walk briskly or run). Walking has to be brisk, done regularly (34 times per week) for 30-60 minutes. The person should be able to talk but not carry out a conversation while they are walking. Carrying hand held, wrist, or ankle weights should be discouraged because of the risk of joint damage.
  - Programs should start with 5 minutes or less depending on the condition of the person and work up to 30-60 minutes gradually to avoid injuries and discouragement.

The Role of Exercise

- Swimming
  - Swimming does have other benefits and provides a mode of exercise for those who cannot exercise on land due to arthritis or other concomitant conditions. It should not be discouraged, however, it should not be advocated as a bone building exercise and clients should understand its benefits and limitations.

The Role of Exercise

- Weight Training
  - May or may not be effective and can be dangerous. If a person has osteoporosis or low bone mass avoid all flexion moments with weights as this increases compression forces on the spine and fracture risk. Do weight training with specificity of function in mind. Functional exercises are better than isolated movements. Work stabilizers isometrically. Work movers isotonically.

The Role of Exercise

- Sports and Dance
  - If a person is a runner or skier or performs any other sport or activity that would not be recommended for people with osteoporosis, they should not be told to give up the activity. People who have been performing a sport on a regular basis for a long period of time have developed a certain level of skill and the muscle strength to safely perform that activity. Over the years, through progressive adaptive bone remodeling, their bones have developed the strength needed to resist forces placed upon them during the activity. They will be less likely to fracture that a person with the same bone density who has not previously performed this activity.

The Role of Exercise

- Weight Training
  - Weight training should be done in a weight bearing position. Maintain good posture and make sure the weights do not come more than about 30° anterior to the frontal plane. Keep moment arms short, keep abdominals contracted, back straight, and knees unlocked. Hip strengthening is especially important to be done in standing because hips need to be strong to support weight during activities against gravity. Closed kinetic chain exercises are functionally superior to seated or Iying open kinetic chain exercises both for muscle strength and the desired effect on bone.

The Role of Exercise

- Sports and Dance
  - They must, however, be counseled about the risk of high impact movements, maintaining good posture during the activity, what movements put them at risk of fracture, and their higher risk of fracture if they fall. For older adults the benefits of performing a sport that they enjoy regularly far outweigh the risks of falling and fracture. And if they do fracture, they will recover much more quickly than a sedentary deconditioned person. Dance is a good exercise activity. It has the benefits of being weight bearing, easy on joints, good for balance and aerobic fitness. Any kind of dance can be recommended such as line dance, square dance, round dance, ballroom, tap, etcetera. Cautions include no flexion moments, maintaining good posture, and risk of falling.

The Role of Exercise

- Sports and Dance
  - Some sports are not recommended for people with osteoporosis. This is especially true for sports with a risk of falling (for example: skiing, sky diving, skating, roller blading) or trauma (for example: hockey, other contact sports) or those which impart a large flexion moment to the spine (for example: rowing, curling, bowling, golfing). If a person has been inactive and wants to start exercising or doing a sport they used to do when they were younger, caution must be used when recommending an appropriate activity. Avoid flexion forces and risks of falling.

Reducing Fracture Risk With Exercise

- Common Problems
  - bone fragility, risk of fracture
  - back/hip pain
  - reduced strength and endurance
  - impaired balance
  - impaired functional capacity and decreased mobility
  - postural abnormalities (thoracic kyphosis)

Reducing Fracture Risk With Exercise

- Specific Exercises
  - general weight-bearing aerobic exercise (1hour, 3x/week)
  - balance exercises
  - stretches (esp. anterior trunk musculature)
  - general strengthening (strengthen lower extremity muscles in a weight-bearing position; theraband/dynaband; free weights)
  - deep breathing exercises
  - spinal extension exercises
  - abdominal exercises (without spinal flexion)
- Contradictions: any form of flexion, hip torsion

Decreasing Compression Forces on the Spine

- Improve posture - decrease thoracic kyphosis
- Maintain good posture during normal daily activities
- Strengthen spinal extensors (strength and endurance)
- Strengthen abdominals without flexion to support the spine and stabilize the pelvis during movement

Prevention of Spinal Fracture Risk

- Factor risk depends on the verbal strength (BMD) and loading
- Average fracture load of a normal healthy vertebra = 3070 +- 1180 N

Supplemental Notes

- Loss of bone - fragile and porous

female	age 35+	-1% / year	50% loss by age 75
	menopausal	-2-4% / year	
male	age 45+	-0.5% / year	15-20% loss by age 75

Activtiy	*Compression Forces on the Spine (N)*	** Fracture Risk for Normal Spine*	*** Fracture Risk for Osteoporotic Spine*
quiet standing	700	<0.2	<0.5
coughing	1100	0.20	0.92
sit ups	1800	0.30	1.50
20 flexion/20 kg load	1850	0.36	1.60
90 flexion/20 kg load	3400	0.44	2.30
90 flexion/	5400	1.10	4.60

* Normal Bone Mineral Density (BMD)

** BMD < 2 s.d. below the normal mean value for age

Limiting load (compression forces acting on the spine) is a promising potential intervention to decrease vertebral fractures

Risk Factors

- Early menopause
- Family history
- Fair (blonde)
- Smoking
- Alcoholism
- Ovary removal
- Vitamin D / calcium deficient

Physical Activity

- Aerobic type, large muscle mass, opposes gravity
- Strength (effective?)
- Osteoporotics - avoid flexion, twisting, forces like jumping
- Measure of bone mineral density - increase (cortical and trabecular)

Other Factors

- Calcium
- Estrogen
- Note of (a lot of) Interest
  - The "Female Triad" (training, ammenorhea, disorder eating)