Osteoarthritis (OA) is not a repetitive strain injury, but it definitely compounds the problems of RSI and shares the symptoms of inflammation and pain. OA can be caused by aging, heredity, injury from trauma or overuse, or disease.\textsuperscript{1,2} It is the most common type of arthritis.\textsuperscript{1} OA is degeneration of the cartilage which leads to inflammation, pain, and stiffness of the joints.\textsuperscript{3} Cartilage is spongy and filled with synovial fluid which lubricates the joints as they move. With OA, the water content of cartilage increases, the protein of the cartilage degenerates, and the cartilage starts to wear away and flake off.\textsuperscript{1} Inflammation of the cartilage can stimulate new bone outgrowths or spurs called osteophytes.\textsuperscript{1}

The symptoms of OA are swollen joints, joint stiffness, joint creaking, and loss of range of motion.\textsuperscript{1} There is no blood test for diagnosing OA.\textsuperscript{1} Diagnosis of osteoarthritis is made by determining if symptoms are present: cracking and popping, inflammation of joints, reduced range of motion, pain and tenderness when joints are moved or pressed on. X-rays of the affected joints will show reduced space within joints, wear at ends of the bones and/or bone spurs.

OA most commonly affects the hands, feet, spine, and large weight-bearing joints such as the hips and knees.\textsuperscript{1} OA doesn’t spread throughout the body, but only affects the joints that have deteriorated.\textsuperscript{4} Where bone spurs have developed in the spine, nerves exiting the spine may be irritated causing numbness, tingling, and severe pain in the back or limbs.\textsuperscript{4} Individuals vary widely with regard to disability which is not necessarily related to the severity of the condition.\textsuperscript{4} In other words, what looks severe in x-rays does not necessarily mean the person feels a lot of pain or vise versa. Symptoms are often intermittent.\textsuperscript{4}
Healthy cartilage has four layers:5,6

- Superficial layer – Flat and spindle-shaped cells parallel to the joint surface containing mostly collagen fibers with high tensile mobility. In mild OA, some roughening and thickening of this layer occurs.5
- Intermediate layer – Cells are rounded and larger than the superficial layer with more proteoglycans and less collagen, with thicker more randomly spaced fibers.5 This layer supports compression forces in the joint. As OA advances, this layer and the deep layer become more disrupted, abnormal cells develop, and inflammatory cells appear.6
- Radial or Deep layer – Cells are rounded and are similar to the intermediate layer, but are arranged in a columnar fashion perpendicular to the surface, also providing resistance to compressive forces.6 Water content is less than the upper two layers and proteoglycans are the most abundant.6
- Calcified layer – The calcified layer has few cells and the purpose of this layer is to anchor the cartilage to the bone. In very advanced cases of OA, cartilage is lacking completely and the bone is exposed.5

Cartilage of the joints has no blood vessels and no nerves, so nutrients are transported to the tissues via the synovial fluid in the joint.5 Repair can be done in a limited fashion through regeneration of the collagen matrix in healthy cartilage with minor injury.5 This is why it is important to prevent injury and improve regeneration capacities of joint cartilage in the early stages.5

*Primary OA* is due to aging and hereditary factors, not injury or disease.1 One hereditary factor includes a defect in the way the body produces collagen, the protein that makes up cartilage.2 Another inherited trait is the way bones are shaped and fit together so the cartilage wears away faster in certain spots.2

*Secondary OA* is brought on by other factors including obesity, repeated trauma, surgery on the joint, abnormal joints at birth, diabetes, or growth hormone disorders.1,2
Heberden’s nodes are hard bony enlargements in the fingers which may form with OA. They are not necessarily painful, but do limit movement of the fingers. Photo courtesy of Wikipedia.org

OA is not related to rheumatoid arthritis or other types of arthritis. There are over 100 types of arthritis! Rheumatoid arthritis is a systemic autoimmune disease where the body’s immune system attacks its own tissues leading to inflammation of the joints and around other organs. Blood tests can show if rheumatoid arthritis is likely, however no tests are available for osteoarthritis.

Factors contributing to OA.
Clearly, if you’re overweight, have played contact sports, you are sedentary, your dietary habits are poor, and you’re getting older, the likelihood of developing OA are relatively high. The most common symptom of osteoarthritis is pain in the joints after repetitive use or after periods of inactivity, such as sitting in a theatre or at a computer for a while. Joint pain is usually worse later in the day. We can’t do anything about growing older or undo old sports injuries, but we can do something about our weight and current habits.

Obesity and overweight. Obesity is the second most powerful risk factor for osteoarthritis of the knees with aging being the first risk factor. Every extra pound you carry can have the impact of four pounds of pressure on your knees and hips as you move. No research has actually shown that losing weight will slow the progression of osteoarthritis, but it is clear that extra body weight adds to the strain on the joints in the back and lower body. Research has shown a link between overweight and OA in the hands. Fat tissues in the body actually produce chemicals (cytokines) that increase inflammation and can damage the joints. So there appears to be two different ways obesity contributes to OA:
1. through adding mechanical stress to the joints and triggering localized low-grade inflammation in the joints (mechaninflammation)
2. through metabolic stress, activation of inflammation through the metabolic system leading to systemic low-grade inflammation, rather than localized inflammation (metainflammation).

Looking at the contributions of weight loss versus increase in inflammatory proteins as factors in pain and function of obese subjects, research has found that weight loss actually had no effect on pain and only a 4% improvement in functionality. A decrease in inflammatory proteins resulted in a 15% decrease in pain and a 29% increase in functionality. This indicates that controlling inflammation is an important factor in improving the status of obese patients (and probably all patients), while weight loss has much less effect. As mentioned above, however, overweight triggers low-grade inflammation in the joints, so even though there was little or no immediate direct effect of obesity, the long-term effects are still counterproductive.
**Metabolic syndrome.** Metabolic syndrome is the presence of at least 3 of these 5 medical conditions: obesity around the midriff, high blood pressure, high blood sugar, high serum triglycerides, and low serum high-density lipoprotein.\(^\text{10}\) Besides being associated with the risk of developing cardiovascular disease, type 1 diabetes, and some cancers, metabolic syndrome appears to be associated with OA.\(^\text{8}\) Evidence from research is not clear.\(^\text{8}\) Some studies show a connection and some don’t, especially after controlling for obesity. One study showed accelerated knee cartilage matrix degradation in people with type 2 diabetes after correcting for ethnicity, age, sex, baseline BMI (overweight), and severity of OA.\(^\text{8}\) It appears that there is some interaction going on, but more research is needed to clarify exactly what factors are related to the development of OA and how they are related.

**High impact sports.** Damage to the joints can begin at the age of 20 if someone participates in high impact sports like football, soccer, tennis, basketball, and high-impact aerobics. Interestingly, long-distance running has not been shown to increase the risk of osteoarthritis.\(^\text{1}\) The question remains whether participation in sports contributes to OA or whether inactivity and associated loss of muscle strength, resulting obesity, metainflammation, or telomere shortening are more important contributors to OA than sports activities.\(^\text{8}\) From a historical standpoint, people tend to be far less physically active today than they were in past generations, especially hunter/gatherer societies.\(^\text{8}\) Reduction in loading on the bones and joints may actually result in weaker, less stable joints that are more susceptible to damage and deterioration, though certainly some types of injuries do lead to high levels of OA.\(^\text{8}\) Hunting and foraging are quite different activities than sports. Regular daily walking, hiking, or running are more similar than multi-directional loading and frequent impact with objects, other players, or the ground in most sports.

**Mismatch factors.** The concept of mismatch factors or mismatch diseases is a theory that our lifestyle today is dramatically different from what the lifestyle of humans has been for most of the past 200,000 years as hunter-gatherers.\(^\text{8}\) In just 12,000 years most of the human population transitioned to farming and agriculture, eating cereals, grains, and domesticated foods, and then to our current post-industrial age which involves very low levels of physical activity and consumption of highly processed or domesticated foods that are high in sugar and fat, low in fiber\(^\text{8}\). This is still a largely untested theory, even though it conceptually makes sense. Our genes were adapted to deal with certain demands and over a relatively short period of time, our lifestyle and diet has changed dramatically and our evolution has been unable to keep up, so there is a mismatch between our genetic adaptation and our lifestyle today.\(^\text{5}\) Although OA has been documented among Paleolithic hunter-gatherers and early farmers, it was far less prevalent after controlling for variation in lifespan. Looking at skeletal remains from 2,576 adults over the age of 50 spanning from prehistoric hunter-gatherers to 21\textsuperscript{st} century city dwellers, it appears that OA is about twice as common today as in early days.\(^\text{5}\) This study found that 25% of the people who died in the past few decades were obese, while only 1% of the remains from earlier times were obese.\(^\text{5}\) In just half a century, the risk of OA of the knee has dramatically increased alongside a steep rise in obesity levels.\(^\text{5}\) Obesity, metabolic syndrome, dietary changes, and physical activity are the four most obvious candidates of preventable mismatch diseases in the past 50 years.\(^\text{5}\)
Weather and Climate. A lot of people who have OA will tell you the weather has an impact on their pain and stiffness. And there have been a lot of studies trying to understand if there is a connection and what that connection might be. Unfortunately, it is difficult to run a long-term study on this topic that is what researchers term double-blind (both the subject and the researcher are unaware of the conditions being tested for each subject) or even single-blind (the subject is unaware of the conditions), since people are pretty aware of the weather and are quite willing to attribute OA difficulties to the conditions. Some studies simply asked subjects if they felt there was a connection, which is a nearly worthless type of research. For studies which find no connection between reported pain and current weather conditions (temperature, relative humidity, barometric pressure, and precipitation) there are other studies which do find a connection. One well-conducted study found a connection between humidity and joint pain, as well as average daily temperature and humidity where the effect of humidity was stronger in colder weather conditions. Changes in weather did not produce an increase in pain as has been a theory regarding the connection of weather to OA. In the end, it appears that some, but not all of the better studies do confirm that weather has a significant effect. Pain and stiffness appear to be worse during cold, damp weather, especially for people with significant joint deterioration.
Prevention

Most sources say there is no way to prevent OA. But recent research on various components in foods (bioactives) is showing great promise in the prevention of cartilage destruction by either directly inhibiting enzymes that break down cartilage or through anti-inflammatory pathways that result in release of enzymes that break down cartilage. A lot more research is required to verify and enable a better understanding of these mechanisms, but things may not be hopeless with regard to prevention! This is covered in much more detail in the Treatment section of this article. But, since this is a preventive measure, try to get the kids and young people in your life to love eating these foods. You might save them a lot of agony later in life. We can all start consciously eating more of these foods right now to halt the progress of cartilage breakdown.

About 1/3 of people in the U.S. from 45-64 years of age have doctor-diagnosed arthritis. About ½ of people in the U.S. 65 years of age or older have doctor-diagnosed arthritis. There are probably many more cases that are unreported and/or not doctor-diagnosed, so these numbers are conservative. And the trend is upwards as population grows, more of the population is older people, and obesity is on the rise.

The best guidelines for avoiding OA are:

- Maintain a healthy weight.
- Get moderate daily exercise for strength, balance, coordination, posture, and cardiovascular fitness.
- Eat foods based on the Mediterranean diet to head off inflammation and ensure a balance of nutrients and a healthy balance of Omega fatty acids.
- Avoid high-impact sports.
- Use good posture when performing all daily activities to avoid unnecessary stress, strain, and twisting of joints.
- Incorporate lots of fruits and vegetables into your diet, especially those listed in the treatment section under “Diet”. Broccoli and veggies in the mustard family are all really good for this, but so are many herbs, licorice root, apples, oranges, and other fruits, hot peppers, and carrots.

Treatment

Evidence of osteoarthritis in humans dates back to 4500 B.C. and has been referred to as the most common ailment of prehistoric people. Evidence of OA has even been found in the remains of dinosaurs. Since this ailment has been around for a very long time, remedies abound from copper bracelets to prescription steroid shots, some highly speculative or somewhat superstitious, and some posing serious side-effects and health risks of their own. There is currently no known cure for osteoarthritis, however there are things that can make life much more comfortable and slow down the progress of deterioration. Doctors ordinarily treat OA with anti-inflammatory medicines and painkillers, but since these all have side effects, it is best to try a natural approach to see if you can manage the pain and reduce deterioration.

Cartilage regeneration is a hot area of research. In most cases, stimulation of cartilage regrowth by various means results in growth of undifferentiated fibrous tissue that does not have good biomechanical properties. There are bits and pieces of the process that are becoming understood, but there is still a lot of work to be done to understand the factors that cause some people’s cartilage
to break down, factors that prohibit regeneration, and factors that may allow for regeneration and differentiation of cartilage.\(^1^7\) There are several fronts being approached.\(^1^8\)

1. Stopping cartilage breakdown.
2. Use of growth factors to aid regeneration of cartilage.
3. Reversing oxidative damage and synovial tissue inflammation.
4. Controlling gene expression as it affects the development of OA.

Basic treatment that aims at improving biomechanics and range of motion, injury prevention, weight control, strengthening, and low-impact exercises should always be the first line of defense. Treatment consists of attempting to aid the ailing joints through strengthening, support, reduction of inflammation, and prevention of further damage to the cartilage, and secondarily to reduce pain.

**Exercise.** When your joints hurt, it is hard to feel motivated to exercise, but that is exactly what will help relieve pain, limber up, lessen joint damage, and help to lose or maintain weight.\(^1^6,6^7\) Many people with OA have decreased muscle strength, physical energy, and endurance because pain encourages a sedentary lifestyle which is a downward spiral.\(^1^9\) More inactivity leads to increased pain and disability as well as greater stress, depression, reduced coping and immune function, and overall reduced quality of life.\(^1^9\)

A review of research examining the benefits of exercise on knee OA found that out of 44 trials, exercise significantly reduced pain, improved functioning, and improved quality of life.\(^2^0\) The form of exercise in the various studies was not consistent, so it is not possible to determine what form or quantity is most effective, and it may be highly individual. It appears that land-based exercise reduced pain 12 points on a scale from 0 to 100, while aquatic exercises reduced pain an average of 5 points on a scale from 0 to 100.\(^2^0,2^1\) Quality of life was slightly higher over non-exercisers with aquatic exercise, though both pain rating and quality of life appear to be short-term benefits to this type of exercise. If you prefer aquatic exercise and find it more comfortable, by all means do it because with any exercise program adherence is critical to gaining results, but round out your exercise repertoire with several other activities as well.\(^1^9\) Few studies have evaluated the effects of exercise on either altering the progression of OA or modifying it in humans, but it is clear that it is effective in managing symptoms.\(^2^2\)

A well-rounded exercise program should encompass some of all of the following activities throughout the week. There are many exercise programs that integrate several, if not all in a session.

- stretching and range of motion
- strength training
- aerobic or endurance exercise
- movement and body awareness like tai chi and yoga
- balance training

Being physically active encourages the production and flow of lubricating joint fluids, builds muscle strength, helps weight control, improves flexibility and joint movement, and eases pain in joints.\(^1^9\) Before starting an exercise program, it is a good idea to check with your health practitioner to determine if there are any specific recommendations or concerns.\(^1^9\) Be aware that Western medicine is often overly cautious about recommending exercise for people with vulnerable joints, but research has shown that it is highly beneficial in a multitude of regards and is highly recommended.\(^1^9\)
There are many low-impact aerobics classes at health clubs and online which minimize jumping and pounding of the joints, yet still allow a great full-body workout.

Bicycling or stationary cycling is great for strengthening the quadriceps above the knee and can help reduce symptoms significantly in arthritis of the knee.

Swimming and water aerobics are good non-impact activities which can improve strength, though some impact is important to regenerate bone.

Yoga can be very helpful in improving fitness, mood, stress levels, quality of life, vitality, physical pain, and walking capacity.19 Sessions involved in one particular study were one hour twice/week with one at-home practice session.19 Even 9 months after the study on yoga, most of the measures were still significantly improved. Hatha Yoga not only increases flexibility, it emphasizes postural alignment, strength, endurance, balance, and breathing in relationship to relaxation.19

Do some form of exercise every single day and make it a habit. Pay attention to your body’s pain levels before you exercise. Alternate or rotate days of various types of activity to make sure you are covering all bases: strength, endurance, cardiovascular fitness, range of motion, and balance. More strenuous days of aerobic exercise or weight training may sometimes result in joint soreness or muscle tightness that will benefit from a day of yoga, tai chi, or pilates. When you are feeling great, take advantage of those days with more energetic workouts. Days when you’re hurting, don’t force heavy exertion, but do participate in activity that will help lubricate joints and improve flexibility. Inactivity is not good when you are stiff and sore. Half an hour of yoga focusing on the areas of stiffness will really help you and make you feel more in control of your body.

Diet
What you eat has a big impact on inflammation and OA pain. Foods are the best way to ingest bioactive nutrients because they supply a complete array of nutrition rather than isolating suspected “active” components and taking those as dietary supplements. It is also much less expensive and if people can learn to incorporate the most healthful foods into their diet, they will benefit from the nutrients without having to remember to pop a handful of pills.

Research is now looking at three categories as targets in treating OA through diet.23 These targets are inflammation, oxidative stress, and catabolic agents (or things that cause the cartilage to break down).23 Designing a diet that addresses each of these targets is the most natural way to incorporate these nutraceuticals.

The Mediterranean or anti-inflammatory diet is advised. We go into quite a bit of detail about the Mediterranean diet in our article on Nutrients, Nutraceuticals, and Healing:


and in our article on Overweight and Obesity:

http://working-well.org/articles/pdf/Overweight.pdf

Hydration is important to maintain body functions, but how much you need is largely a factor of how active you are, how dry or hot the weather is, how much water content is in the foods you have consumed, and many other factors.24 You can pretty much disregard all hard and fast rules about drinking 8 glasses of water a day. The best way to tell if you are consuming enough water is by the color of your urine.24 Dark urine means you are not drinking enough water. Very pale urine means you can back off. Urine should be pale straw colored. If that is what you see, you can relax and stop worrying. Thirst is usually an accurate way to tell if you need to drink more fluids, too. Older people should rely more on the color of their urine because they may not feel thirsty when
they are actually becoming somewhat dehydrated. If you want to read more about the topic of hydration, please read our article on the subject:
http://working-well.org/articles/pdf/Hydration.pdf

**Anti-catabolic foods.** Certain foods have been found that reduce the breakdown of cartilage (catabolism).

A compound in broccoli and other plants in the brassica family, sulforaphane, has been found to block the enzymes that cause joint destruction in osteoarthritis. Eating broccoli leads to a high level of sulforaphane in the blood, the plasma, and synovial fluid. Sulforaphane has been shown to inhibit the production of pro-inflammatory compounds in the body as well as inhibiting degradation of proteins and collagen in cartilage. All members of the mustard family have high levels of sulforaphane and they are termed cruciferous vegetables.

The table below shows the amount of glucoraphanin (the precursor of sulforaphane) in various foods. A more exhaustive listing is available in Reference 31. Clearly broccoli is not the top candidate, but it is one of many foods that contains this compound. It should be noted that glucoraphanin is water-soluble and easily destroyed by heat, so eating raw, or gently steaming or microwaving will reduce losses. Average losses during cooking are approximately 36%.

<table>
<thead>
<tr>
<th>Food (raw)</th>
<th>Serving in grams</th>
<th>Total Glucosinolates (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broccoli sprouts</td>
<td>1+ cups (100 gms)</td>
<td>250</td>
</tr>
<tr>
<td>Wasabi powder</td>
<td>1 teaspoon (2.5 gms)</td>
<td>67</td>
</tr>
<tr>
<td>Garden cress</td>
<td>1/2 cup (25 gms)</td>
<td>98</td>
</tr>
<tr>
<td>Mustard Greens</td>
<td>1/2 cup, chopped (28 gms)</td>
<td>79</td>
</tr>
<tr>
<td>Brussels sprouts</td>
<td>1/2 cup (44 gms)</td>
<td>104</td>
</tr>
<tr>
<td>Horseradish</td>
<td>1 Tablespoon (15 gms)</td>
<td>24</td>
</tr>
<tr>
<td>Kale</td>
<td>1 cup, chopped (67 gms)</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>1 cup, chopped (34 gms)</td>
<td>32</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------------------</td>
<td>----</td>
</tr>
<tr>
<td>Watercress</td>
<td>1 cup, chopped (34 gms)</td>
<td>32</td>
</tr>
<tr>
<td>Turnip</td>
<td>1/2 cup, cubes (65 gms)</td>
<td>60</td>
</tr>
<tr>
<td>Cabbage, savoy</td>
<td>1/2 cup, chopped (45 gms)</td>
<td>35</td>
</tr>
<tr>
<td>Cabbage</td>
<td>1/2 cup, chopped (45 gms)</td>
<td>29</td>
</tr>
<tr>
<td>Broccoli</td>
<td>1/2 cup, chopped (44 gms)</td>
<td>27</td>
</tr>
<tr>
<td>Bok Choy (pak choi)</td>
<td>1/2 cup, chopped (35 gms)</td>
<td>19</td>
</tr>
<tr>
<td>Kohlrabi</td>
<td>1/2 cup, chopped (67 gms)</td>
<td>31</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>1/2 cup, chopped 50 gms</td>
<td>22</td>
</tr>
</tbody>
</table>

Further research by the same group, the University of East Anglia in Norwich, UK, went further and profiled 96 diet-derived, primarily plant-based bioactive substances in the lab. Four bioactives were determined to have the most activity with regard to regulating the genes relevant to cartilage destruction and OA:

- apigenin – a flavonoid found in many fruits and vegetables including apples, oranges, celery, onions, oregano, parsley, tarragon, basil, cilantro, chamomile, bell peppers, garlic, guava, and bacopa monnieri.\(^{14,32}\)
- isoliquiritigenin – a flavonoid found in licorice root
- luteolin – a flavonoid found in fresh thyme, parsley, fresh peppermint, hot raw chili peppers, onions, carrots and olive oil\(^ {14}\)
- sulforaphane – see above for food sources.

All four bioactives were found to have a significant ability to inhibit cartilage degradation correlated with dosage in laboratory tests.\(^ {14}\) Testing determined that isoliquiritigenin and luteolin had a dose-dependent inhibition of antioxidants which are a direct pathway to cartilage destruction. The other two players, sulforaphane and apigenin, both inhibit various signaling pathways indirectly operating to repress the enzymes that break down cartilage.\(^ {14}\)

The research went one step further to determine if there was a synergistic effect of combining two, three, or all four of the bioactives since foods are rarely eaten alone.\(^ {14}\) These trials were done with human cartilage. The only combination that acted synergistically was sulforaphane and isoliquiritigenin and it was a robust effect. Combining sulforaphane and apigenin, as well as combining apigenin and isoliquiritigenin showed results that were about equal to each bioactive acting alone, or additive. Combining sulforaphane and luteolin, as well as all the three and four bioactive combinations actually resulted in less inhibition of the cartilage degrading enzymes than each single one alone, so they seemed to reduce the effectiveness of each other.\(^ {14}\)

Another study looked at the effects of diallyl disulfide found in garlic, onions, and other plants in the allium family.\(^ {33}\) This was a study of about 1000 female twins who were not overweight comparing their dietary habits to find trends that might indicate whether alliums help prevent OA in the hip.\(^ {33}\) This type of study is very difficult to draw conclusions, since there are so many variables that could be attributed to OA other than diet, however the conclusion of the study was that a diet high in non-citrus fruits and alliums showed an inverse relationship to OA of the hip.\(^ {33}\)

In terms of preparing meals and diets to reduce cartilage degradation, the bottom line is to focus on incorporating many of the flavonoids that have shown preliminary promise. Don’t be a fanatic
about excluding other produce! There are so many incredible nutrients in fruits and vegetables that have nothing to do with OA, but provide a wide array of health benefits. Variety is the best idea when dealing with any diet recommendation. Sulforaphane is the most-researched and so including those foods on that list should top the list of anybody trying to prevent cartilage degradation. There are many ways to prepare any of these vegetables to help mask the strong odor and flavor, if that is objectionable and make sure not to overcook them! Mayonnaise dip or sesame oil and soy sauce (or Bragg’s liquid aminos) are simple and delicious ways to serve broccoli, broccolini, or brussels sprouts.

Licorice root is probably a bit trickier to find, but it is incorporated into many herb tea blends. The remainder of the useful flavonoids can be used to season foods by the many herbs on the list, and a generally healthy diet incorporating plenty of fresh fruits and vegetables.

**Antioxidants and Anti-inflammatory foods.**

Some research has been done to investigate whether dietary antioxidants have an effect on knee OA. It is too soon to determine whether antioxidants have an effect on OA or cartilage health, but at this time, the research has found little to no evidence of benefit.

One study found that higher levels of Vitamin C were associated with higher incidence of knee OA, though the effect was not linear. Vitamin C dietary consumption levels in the range of 81 to 136 mg/day were found to have the highest incidence of OA, while levels either lower or higher that that range were associated with less OA. It is unknown what impact supplementing with much higher dosages of Vitamin C has on OA.

Green tea is another powerful antioxidant. Human studies are lacking, but animal research has shown a lowered incidence of OA and slower progression of the disease with consumption of green tea primarily as a result of reduced inflammatory proteins.

Pomegranate fruit or juice is also a powerful antioxidant and anti-inflammatory aid. Human research is lacking, but animal studies have found that a two-week period of consumption of pomegranate significantly reduced cartilage damage and proteoglycan (proteins composing cartilage and connective tissue) loss, especially in groups receiving higher doses.

Ginger and turmeric have strong anti-inflammatory effects and possibly antioxidant properties. Curcumin (in turmeric) appears to also have an anti-catabolic effect. Curcumin has been found to have a large and clinically important effect on reduction of pain in the short term. Ordinarily, turmeric is not absorbed by the body well. Addition of black pepper while consuming turmeric increases absorption by twenty-fold. Curcumin is discussed further in the section on supplements, but incorporating these spices into the diet is encouraged. Indian food makes generous use of both!

Resveratrol has anti-inflammatory properties. It is found in grapes, berries, and peanuts.

Rose hips, specifically Rosa canina, have been studied in a few trials, but quality of the research and bias toward specific products has interfered with determining its efficacy. There is moderate evidence that Rosa canina products reduce pain and stiffness, but not functionality of joints with OA.

Correct dietary Omega fatty acid balance has an anti-inflammatory effect. Research has shown that Omega-6 fatty acids not only increase inflammation, but they are associated with knee
Overall, the effect of taking Omega-3 fatty acid supplements on OA pain appears to be small. These generally consist of fish oil, krill oil, or green lipped mussel oil. Of the three, green lipped mussel oil shows the most promise and in a review of research, it was the only supplement, as well as undenatured type II collagen, that showed not only short-term reduction in pain, but medium term reduction in pain. Not enough solid research has actually been done to conclude whether fish oil supplements relieve pain and some research has significant flaws in implementation. Research on benefits to functionality is lacking which is often different from the results from pain reduction. Since supplements do help improve the balance of Omega-3 to Omega-6 fatty acids and a higher ratio of Omega-3 to Omega-6 is known to reduce inflammation, it is likely that supplements cannot hurt and might help reduce inflammation and flexibility of joints with OA. We suggest that people try some for a while and if it helps, use them. But, best yet, do your best to improve your diet by reducing consumption of Omega-6 fatty acids and consuming more Omega-3’s. Supplements are often used as a remedial effort rather than changing one’s dietary habits.

The association between circulating levels of various fatty acids and OA is not clear. One study measured circulating levels of saturated fatty acids, monounsaturated fatty acids, polyunsaturated fatty acids, omega-3 and omega-6 fatty acids in fasting men and women with knee and hand OA. Higher levels of all fatty acids were positively associated with hand OA in men only. It is interesting that there was no association at all in women with knee or hand of OA.

Other research has been mixed with regard to the benefits of Omega-3, but one recent study looked specifically at the ratio of Omega-6 fatty acids to Omega-3 fatty acids on:
- Functional limitations caused by pain
- Measures of pain derived from applying pressure to various points
- Psychosocial measures including depression, stress, positive/negative emotions, and optimism.

Blood samples were taken and the ratio of Omega-6 to Omega-3 fatty acids were derived for each of the 167 participants aged 45-85 years. People with lower ratios had significantly fewer symptoms of knee pain, better functioning, and less psychosocial distress than the people with high ratios of Omega-6 to Omega-3. The people with the high ratio averaged 9.92, almost twice the recommended ratio of less than 5, while even the people with the low ratio averaged 5.08 which is the top end of the recommended ratio. 21% of the people with lower ratios reported taking some type of Omega-3 supplements while only 5% of the high ratio group reported taking supplements. Variables that were not a factor included age, sex, employment status, marital status, and exercise frequency. Smoking and obesity were significantly associated with a high ratio score. Diet was not directly investigated in this study, but it was surmised that there were likely significant differences in dietary habits between the two groups based on the other evidence gathered.

**Supplements and Neutraceuticals**

The USDA utilizes the term dietary supplement to describe pills, powders, and other non-food compounds. Neutraceuticals are generally considered the bioactive chemical compound derived from a food, but available in a non-food form. It’s always easier to pop a pill than to make lifestyle modifications, but most supplements available have still not been found to be conclusively helpful in dealing with OA. Many can help with the pain and inflammation, but few, if any have been
shown to reverse or diminish the deterioration of the joints. Supplements may help, but the biggest things you can do to improve the situation are the suggestions preceding this section.

In reviewing the research, it seems as though almost everything under the sun has been tested for its effect on OA in at least one study. We’ve limited our scope to some of the most common and/or effective supplements. Some of the supplements most commonly recommended have not been found to be the most effective, while some little-known supplements have shown fairly substantial benefits. Supplements account for $25 billion of consumer spending. Of this, $872 million are glucosamine and chondroitin. Unfortunately, a large number of studies are of very poor quality or are likely biased due to conflict of interest, individuals, companies or pharmaceuticals manufacturing products they wish to promote, etc. The following two charts summarize the findings from numerous studies with various risk of bias. The first chart shows the effectiveness of each supplement on pain in the short-term, medium-term, and long-term. The second chart shows the effectiveness of each supplement on function in the short-, medium-, and long-term. Take these results with a grain of salt because of possible bias and limited number of studies, but the results are fairly surprising. If a person is to maximize dollars spent on supplements, it makes sense to focus on the ones that show the most promise for pain or function in the short or medium term. Clearly, the ever-popular glucosamine and chondroitin do not make that list. Vitamin E appears to actually be counterproductive. Nothing seemed to help in the long term, but at least there is hope for more immediate relief.

Pick and choose what you take away from these charts, but it appears that the following list of supplements would be the top pick for pain and/or function improvement:

- Undenatured type 2 collagen and/or collagen hydrolysate
- Curcumin and/or curcuma longa extract
- Passionfruit peel extract
- Pycnogenol
- Boswellia serrata extract
- L-carnitine
- Green lipped mussel extract (Omega-3)
- SAMe (s-adenosylmethionine)
Effectiveness of Supplements on Pain

Table from Reference 35
**Effectiveness of Supplements on Function**

<table>
<thead>
<tr>
<th>Supplements</th>
<th>Trial(s)</th>
<th>Total No.</th>
<th>SMD (95% CI)</th>
<th>I², %</th>
<th>Favors supplement</th>
<th>Favors placebo</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Short term</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin E</td>
<td>1</td>
<td>77</td>
<td>-0.10 (-0.55 to 0.35)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Artemisia annua extract</td>
<td>1</td>
<td>39</td>
<td>-0.15 (-0.61 to 0.50)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Willow bark extract</td>
<td>2</td>
<td>162</td>
<td>-0.24 (-0.55 to 0.07)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diacerein</td>
<td>4</td>
<td>427</td>
<td>-0.35 (-0.54 to -0.16)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bromelain</td>
<td>1</td>
<td>32</td>
<td>-0.34 (-1.04 to 0.36)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chondroitin</td>
<td>8</td>
<td>1200</td>
<td>-0.36 (-0.58 to -0.13)</td>
<td>70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glucosamine</td>
<td>10</td>
<td>1189</td>
<td>-0.45 (-0.73 to -0.17)</td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avocado/soybean unsaponifiables</td>
<td>2</td>
<td>385</td>
<td>-0.48 (-0.63 to -0.28)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undenatured type II collagen</td>
<td>1</td>
<td>107</td>
<td>-0.55 (-0.94 to -0.17)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methylsulfonylmethane</td>
<td>3</td>
<td>148</td>
<td>-1.10 (-1.81 to -0.38)</td>
<td>76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curcumin</td>
<td>1</td>
<td>40</td>
<td>-1.13 (-1.60 to -0.46)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boswellia serrata extract</td>
<td>3</td>
<td>186</td>
<td>-1.15 (-1.63 to -0.68)</td>
<td>51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-carnitine</td>
<td>1</td>
<td>69</td>
<td>-1.15 (-1.66 to -0.64)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curcuma longa extract</td>
<td>1</td>
<td>58</td>
<td>-1.27 (-1.83 to -0.70)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passion fruit peel extract</td>
<td>1</td>
<td>33</td>
<td>-1.55 (-2.33 to -0.77)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pycnogenol</td>
<td>2</td>
<td>182</td>
<td>-1.84 (-2.32 to -1.35)</td>
<td>36</td>
<td></td>
<td></td>
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<tr>
<td>Overall</td>
<td>42</td>
<td>4344</td>
<td>-0.53 (-0.62 to -0.45)</td>
<td>79</td>
<td></td>
<td></td>
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<tr>
<td><strong>Medium term</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin E</td>
<td>1</td>
<td>72</td>
<td>0.14 (-0.32 to 0.60)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collagen hydrolysate</td>
<td>2</td>
<td>237</td>
<td>0.11 (-0.57 to 0.78)</td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glucosamine</td>
<td>3</td>
<td>1041</td>
<td>-0.03 (-0.28 to 0.21)</td>
<td>71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chondroitin</td>
<td>6</td>
<td>1246</td>
<td>-0.22 (-0.42 to -0.01)</td>
<td>59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diacerein</td>
<td>1</td>
<td>480</td>
<td>-0.24 (-0.44 to -0.03)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avocado/soybean unsaponifiables</td>
<td>1</td>
<td>162</td>
<td>-0.58 (-0.94 to -0.23)</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undenatured type II collagen</td>
<td>1</td>
<td>107</td>
<td>-0.59 (-0.98 to -0.20)</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>15</td>
<td>3345</td>
<td>-0.22 (-0.33 to -0.12)</td>
<td>57</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Long term</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin E</td>
<td>1</td>
<td>117</td>
<td>0.28 (-0.1 to 0.6)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collagen hydrolysate</td>
<td>1</td>
<td>29</td>
<td>0.22 (-0.51 to 0.95)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diacerein</td>
<td>1</td>
<td>493</td>
<td>0.00 (-0.18 to 0.18)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avocado/soybean unsaponifiables</td>
<td>2</td>
<td>508</td>
<td>-0.03 (-0.21 to 0.14)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glucosamine</td>
<td>4</td>
<td>939</td>
<td>-0.17 (-0.34 to -0.00)</td>
<td>41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chondroitin</td>
<td>3</td>
<td>387</td>
<td>-0.34 (-1.06 to 0.39)</td>
<td>85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin D</td>
<td>4</td>
<td>1136</td>
<td>-0.36 (-0.61 to -0.11)</td>
<td>74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>16</td>
<td>3609</td>
<td>-0.09 (-0.18 to 0.00)</td>
<td>67</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Pycnogenol.** Pycnogenol is a type of pine bark extract. A review of research on dietary supplements for treating OA found a significant moderate reduction of pain in the short term, a significant large improvement in physical function, non-significant improvement in stiffness all in the short term. There was no significant improvement in medium or long term pain or functionality.35
Type 2 collagen. It is important to pay attention to what type of collagen is contained in supplements. Types 1 and 3 contribute to healthy skin, muscles, bones, hair, and fingernails. Types 1 and 3 collagen are derived primarily from beef cartilage. Type 2 collagen contributes to healthy joints and cartilage. Type 2 collagen is derived primarily from poultry cartilage.

Hydrolyzed collagen means the bonds of the long chains of collagen protein have been broken down into smaller sections with a water process, which makes it easier for the intestines to absorb. This type of Type 2 Collagen has been shown to help relieve pain in the short term.

Undenatured type 2 collagen, specifically a patented product called UC-II, has been studied and found to improve pain, stiffness, and functionality in the knee for both people with and without OA. 40 mg of UC-II taken orally at bedtime works with the immune system to reduce inflammatory cytokines, so inflammation is reduced. This type of type 2 collagen has been shown to reduce pain in short and medium term, but not long term.

Passionfruit peel. The peel of Passiflora edulis has been used as a traditional medicine in South America. One double-blind study of 33 OA patients found that pain was significantly reduced after 60 days of use, while patients who received a placebo experienced an increase in pain. There is not enough scientific research to conclude that this is an effective treatment, what is the active component, or what dosage is effective, but it is worth further study.

L-carnitine. Carnitine is derived from an amino acid and is found in most cells in the body. It is derived primarily from meat and dairy products and it is used by the body to produce energy and transports toxic compounds out of the cells. Generally, humans do not require supplementation if the diet contains adequate meat and milk products. Aging affects the concentration of carnitine in the tissues. L-carnitine tartrate has specifically been studied in women with knee OA. 750 mg of l-carnitine tartrate was given in 250 mg doses three times daily for 8 weeks. Pain, stiffness, and physical function were all significantly reduced and were significantly improved over patients receiving a placebo. L-carnitine is well-tolerated with no adverse effects on blood lipid levels.

Another study with the same dosage and similar subjects found that l-carnitine tartrate significantly reduced levels of IL-1β and matrix metaloproteinases (MMP-1), however CRP and MMP-13 blood serum levels did not change significantly. IL-1β and CRP are inflammation markers. The presence of the inflammatory cytokines IL-1β, CRP, and others can lead to the production of enzymes that break down cartilage (MMP-1 and MMP-13). In two separate studies conducted by different researchers, pain was significantly decreased in patients who received l-carnitine, but not in subjects who received a placebo. In one study, blood serum levels of IL-1β was not associated with joint stiffness or functionality and CRP had no effect on pain, stiffness, or functionality. In conclusion, it is too early to determine whether l-carnitine would be effective in OA affecting other joints or in men. The mechanism by which it operates is also unknown, but hopefully more research will be done to delve into this further. At this point, it appears quite promising at least for women with knee OA.

Turmeric and Boswellia serrata. Turmeric is an Ayurvedic remedy for reducing inflammation and is the root of the plant in the ginger family. Curcumin is the active ingredient in turmeric so most supplements use the name curcumin because they are a more concentrated source. Look for supplements that contain some black pepper (piperine) to greatly increase the amount of curcumin.
your body absorbs and take them with a fatty meal since it is a fat soluble compound. turmeric has been well-researched. it is effective in reducing pain in OA and is an effective COX-2 inhibitor, serving to reduce inflammation. it is as effective as ibuprofen or diclofenac, but doesn’t present the side effects and gastrointestinal problems experienced with the drugs.

Boswellia serrata is also known as Frankincense. Both Curcumin and Boswellia extracts have been found to significantly reduce symptoms of OA after 3 months of use. Interestingly, even a placebo caused similar increase in functional measures and reduction in pain after four weeks of treatment, but after continued use, both Curcumin and Boswellia alone or taken together provided significant lasting benefits. The two substances together were more effective than either alone. This may be because Boswellia improved absorption of the Curcumin, though it could be other interactive effects as well.

In conclusion, it is best to look for a supplement that contains a combination of curcumin, Boswellia, and pepperine or black pepper. Organic sourcing is preferred.

Glucosamine and Chondroitin. Some very well-controlled studies have been conducted, but the findings are still inconclusive, with these supplements sometimes indicating significant improvement in OA patients and other times, not. Glucosamine is thought to promote formation and repair of cartilage, while Chondroitin is believed to increase water retention and elasticity in cartilage and to inhibit enzymes that break down cartilage. The effect of these two treatments is not synergistic, so even though supplements often include both glucosamine and chondroitin, they do not work together in aiding cartilage. Some research indicates that these two compounds taken along with Omega-3 fatty acids and/or hyaluronic acid improve joint health, properties of synovial fluid, and helps regulate the chemistry of the joint. A review of research on chondroitin as it affected joint space width (a decrease in joint space width indicates joint degeneration) and pain after treatment for an average of 21 months were varied. Most studies found that chondroitin sulfate reduced the loss of joint space width. Research was not consistent on either joint space measures or pain reduction.

The Osteoarthritis Research Society International has rated both glucosamine and chondroitin as not appropriate in modifying OA and rated as uncertain for symptom relief.

Glucosamine is derived from the shells of crustaceans like shrimp, lobster, crab, and crawfish. Cartilage and connective tissues of animals also contain glucosamine, but like crustacean shells, they are not easily incorporated into the diet. So, for this reason, supplements are the easiest way to ingest glucosamine if you want to see if it helps you.

Olive oil. There is very little research on the effects of olive oil in aiding OA. Research on rats has shown that olive oil in the diet improved cartilage recovery following anterior cruciate ligament surgery. In Iran, olive oil is topically applied to the affected joint. It is difficult to determine whether the effect is due to the olive oil or the massage, though as discussed later, massage alone has inconclusive effect on OA. One double-blind study found that this improved both pain levels and physical functioning in knee OA. More research is required to verify the use of olive oil in either diet or topically as a treatment for OA, but it is a main component of the highly recommended Mediterranean diet and is known to reduce inflammation.

SAM-e (S-adenosylmethionine). SAM-e is synthesized by the body, but is sold as a supplement in the U.S. because higher amounts than normally produced by the body can have several benefits. There are no dietary sources of SAM-e. A substantial body of research indicates that SAM-e can relieve symptoms of OA, is about as effective as standard anti-inflammatory drugs at reducing
inflammation and pain, though it can take 2-4 weeks to be effective.\textsuperscript{59,60,61} SAM-e was not included in the analysis by Ref. 35, so it does not appear in the preceding tables comparing various supplements. SAM-e appears to be quite safe, only occasionally causing mild digestive distress, though not causing damage to the stomach that most pain relievers do.\textsuperscript{59,61}

SAM-e is expensive at the recommended dosage of 600 mg to 1,200 mg daily, so only 400 mg to 800 mg may be necessary for some people.\textsuperscript{61} Start with at least 400 mg (200 mg twice daily), and adjust the dosage after two weeks. If it is effective at that dosage, try reducing it to 100 mg two times daily (200 mg daily). Since it is so safe, people with severe OA symptoms may find it worth the cost.\textsuperscript{26}

Sam-e works closely with vitamins B-12, B-6, and folate, so it is best to supplement with B vitamins while taking this supplement to maximize effectiveness.\textsuperscript{61}

To avoid gastrointestinal distress, choose enteric-coated “butanedisulfonate” products and do not buy bargain brands which may not contain the advertised dosage.\textsuperscript{62} There are several possible drug interactions with other pain killers, antidepressants, and treatments for diabetes and Parkinson’s disease, so if you are on other medications, consult with your doctor before trying it.\textsuperscript{59,62}

Avocado Unsaponifiables (ASUs). Several controlled studies showed promise of ASUs in relieving symptoms of OA, particularly knee OA. There was no significant difference between dosages of 300 mg or 600 mg daily.\textsuperscript{13} A more recent meta-analysis of research has resulted in an uncertain recommendation from the Osteoarthritis Research Society International.\textsuperscript{57} There may be a small benefit in relieving pain, especially in knee OA.\textsuperscript{57}

Cetylated Fatty Acids. These naturally occurring fatty acids can be used as either a topical cream or as a supplement. Solid controlled studies have shown that either of these appear to significantly reduce swelling and pain while increasing mobility. Results are preliminary, but so far these look promising.\textsuperscript{28} A typical oral dose of Cetylated Fatty Acids is 1,000 to 2,000 mg daily. Creams are applied 2-4 times daily.\textsuperscript{28}

MSM (methylsulfonylmethane). Research on MSM is lacking, though the claim is that MSM is supposed to help relieve the pain associated with OA. Chemically, it is related to DMSO (dimethyl sulfoxide), a chemical solvent, which is no longer approved as a supplement because of a large range of adverse reactions.\textsuperscript{23} How MSM is used by the body is not well understood, though it contributes to the sulfur in the body which can be used to synthesize certain amino acids (protein building blocks), and it can act as an antioxidant.\textsuperscript{23} Evidence does not strongly support use of MSM as a supplement.\textsuperscript{23}

Yucca, Mangosteen, Copper bracelets, magnets, etc. – No scientific evidence shows that these types of remedies are effective at all.\textsuperscript{40, 41}
**Therapies**

The Osteoarthritis Research Society International now recommends *balneotherapy* for patients with multiple-joint OA and uncertain recommendation for knee-only OA. Balneotherapy consists of baths containing thermal mineral waters such as Dead Sea salt, mineral waters, sulfur baths, and radon-carbon dioxide baths. Although this therapy is centuries old and may seem completely self-indulgent, there is enough research to support its effectiveness. Heat improves circulation, improves breathing and blood circulation, and lowers stress. Although hydrogen sulfide (H₂S) is life-threatening and corrosive, a very low content has been shown to promote positive effects stimulating cellular defense systems and inducing healing. Even a warm Epsom salt bath in your own tub is likely to provide relief.

Use of *TENS* (transcutaneous electrical nerve stimulation) or *ultrasound* has an uncertain effect on knee OA and is not recommended at all for multiple-joint OA. Electrotherapy/neuromuscular electrical stimulation are both considered inappropriate until further research is done. Electromyograph biofeedback has not been shown to be beneficial in strengthening exercise pain, function, or muscle strength.

Research findings are mixed as to whether *acupuncture* helps, but in many cases, it does improve function and reduces pain. A review of four studies of the effects of acupuncture on hip OA compared to sham acupuncture controls found virtually no effect on either pain or functioning. Another review of ten studies of the effects of acupuncture on knee OA found significant pain reduction and increased functioning in the short term (up to 13 weeks) and significantly improved functioning in the long term (up to 26 weeks), but not improved pain. Currently, the Osteoarthritis Research Society International reports that results are uncertain in its treatments of OA and the American Academy of Orthopaedic Surgeons recommends against acupuncture in knee OA because it finds that evidence against its effectiveness as compelling.

*Manual therapy* has received an inconclusive rating from the American Academy of Orthopaedic Surgeons because it finds that there is neither sufficient evidence that it benefits or harms patients with knee OA. Manual therapy included joint mobilization, joint manipulation, chiropractic therapy, patellar mobilization, myofascial release, or Swedish massage.

**NSAIDs, topicals, and pharmaceuticals**

All NSAIDs, regardless of dose, have been found to be effective for the pain of OA. The Osteoarthritis Research Society International recommends topical *NSAIDs* for knee-only osteoarthritis which is safer and better tolerated than oral NSAIDs. The American Academy of Orthopaedic Surgeons highly recommends the use of oral or topical NSAIDs or Tramadol for knee OA. Most NSAIDs risk complications of serious gastrointestinal, cardiovascular, and kidney or liver damage. Diclofenac is associated with the highest rate of liver abnormalities. Unfortunately, 150 mg of diclofenac was found in 74 trials to be the most effective for helping pain...
Celecoxib was associated with fewer gastrointestinal problems over ibuprofen or naproxen. Celecoxib was also associated with kidney and high blood pressure problems compared to ibuprofen. Pick your poison, but it is best to explore more natural ways to control pain and functionality if possible. Save these options for flare-ups and short-term use.

Four research articles were reviewed that studied the effect of NSAIDs on the structure of joints affected by OA. The NSAIDs celecoxib, diacerein, and diclofenac were included. There was no significant difference in joint space width or in pain reduction with any of the three NSAIDs over a placebo. What this means is that NSAIDs help with pain, but they are not a cure and they don’t lessen the severity of the physical condition in any way.

Acetaminophen is generally recommended for OA for short-term pain relief, though the American Academy of Orthopaedic Surgeons withholds a recommendation for its use due to research it found inconclusive. Acetaminophen has negative effects on the gastrointestinal tract and can cause multi-organ failure with long-term use, so is not recommended as a long-term solution to pain management.

Capsaicin creams have been found to be beneficial for knee OA and uncertain benefits for multi-joint OA. Although it was found that there was 50% more pain reduction with users of capsaicin creams than a placebo, there was also a significant increase in adverse effects such as skin reactions. Overall, it is a fairly successful, inexpensive treatment available over-the-counter and is probably worth trying. Capsaicin is the compound in hot peppers that makes them hot and it operates by altering the pain messages sent to the brain. It creates a stinging or burning sensation at first which may be unpleasant. Massage the cream or gel into the skin until it disappears, then wash hands thoroughly to avoid getting it in the eyes, mouth, or on other sensitive tissues. Capsaicin cream should not be applied to damaged, irritated, or broken skin or wounds, should not be used with a heating pad, should not be bandaged or wrapped, and should not be used after or during swimming, bathing, sunbathing, hot tubbing, or after heat exposure to avoid skin sensitivity. It is really simple to make your own capsaicin cream with organic ingredients! Mix 1 Tablespoon of organic cayenne pepper into 5 Tablespoons of organic raw coconut oil.

Duloxetine. The pharmaceutical duloxetine has been found to be beneficial for most types of OA. A review of research on patients with knee OA found significant reduction in pain (up to 50%) and functionality over trials of 10-14 weeks. It has not been found to cause abnormalities in x-rays or in knee joint mobility. It can cause nausea, dry mouth, drowsiness, fatigue, insomnia, constipation, decreased appetite, and water retention in 7% or less of patients, which was a significant effect over a placebo. More research is needed, especially to determine long-term adverse effects of the drug, but if tolerated, this drug appears to reduce pain and increase functionality effectively at least for short-term use.

Opioids. The positive effects of either transdermal or oral opioids for knee and hip OA are uncertain and quite prone to experiencing adverse effects of the drug. The Osteoarthritis Research Society International and the American Academy of Orthopaedic Surgeons have given them an uncertain recommendation overall and conclusion that they have limited usefulness for long term treatment.

Corticosteroids. The American Academy of Orthopaedic Surgeons makes no recommendation about the use of corticosteroids in knee OA due to inconclusive evidence in the research.

CBD, marijuana, and synthetic cannabidiol. Almost no human research has been conducted on cannabis products to determine their usefulness in the treatment of OA, but that is changing.
There are plenty reports about the relief marijuana products give to OA sufferers and it has been used since 2737 B.C. in Traditional Chinese Medicine. But it is important to identify in formal research studies what strains and dosages are effective, when and if it is effective for all types of OA, how it works in the body, as well as possible side effects. The body has an innate endocannabinoid system (ECS) consisting of receptors, proteins, and signaling enzymes which has been shown to relieve pain from inflammation and nerves. Use of cannabinoids appears work directly within this unique system by acting on the nerves in the joints to reduce pain. Current research in Canada sponsored by the Arthritis Society and funded at least partly by producers of medical marijuana (Aphria, Inc. and Peace Naturals Project). As with most treatments that are derived from plant sources, natural sources and use of a broad spectrum of components in the plant are often more effective than synthetic or isolated compounds and may have fewer side effects. This three-year study is under way as of this writing and findings will be reported in a year or two.

One study used a synthetic cannabidiol gel applied topically to people with knee OA. 250 mg of the gel resulted in a significant improvement in the average weekly worst pain score of at least 30% and improvement in physical function of at least 20%. Men were found to respond more to the treatment than women.

**Intrusive remedies**

*Honey Bee Venom.* Bee venom has been used to treat arthritis for over 2,000 years and it contains many anti-inflammatory properties. Many of the active components of bee venom are peptides, one of which is melittin which stimulates the body to produce cortisone 100 times more potent than hydrocortisone. Many other peptides in bee venom act in beneficial ways to reduce inflammation, immunological effects and have multiple other beneficial effects. In addition to anecdotal evidence and common knowledge among beekeepers that this treatment works, some controlled research indicates that bee venom, either injected or used at acupuncture sites, can provide significant relief to people suffering from OA, as long as they are not sensitive or allergic to bee venom. Several deaths following successful honey bee venom acupuncture due to anaphylaxis in an allergic response. It has been suggested that safety of bee venom may be increased with refinement and removal of harmful substances to reduce its toxicity.

**Corticosteroid injection** into joints for short-term pain management of all types of OA has been recommended by the Osteoarthritis Research Society International. It is not recommended for long-term treatment and pain management due to side effects of corticosteroids.

Research on injection of hyaluronic acid into joints with OA for an average of 16 months showed inconsistent results in the effect on joint space width and pain. Unfortunately, all three studies were flawed due to procedural or design flaws, or industry-supported bias. More research is required to determine if this treatment is effective. Currently, the Osteoarthritis Research Society International does not recommend this treatment for most OA, with uncertain status for knee-only OA. The American Academy of Orthopaedic Surgeons strongly recommends against the use of hyaluronic acid injections with evidence against its use consistent and compelling.

**Arthroscopic surgery** in knee OA has been found to be of no benefit over regular non-invasive treatments, so is now strongly advised against.

**Supports**

Use of knee braces, knee sleeves, foot orthoses, and walking canes are recommended for knee OA by the Osteoarthritis Research Society International. Wearing shock absorbing insoles, shoes, or orthopedic shoes can help in daily activities and during exercise. (See Resources). The American Academy of Orthopaedic Surgeons found inconclusive evidence that neither a valgus directing
force brace (sleeve or rigid brace) nor wedge insoles are effective for knee OA, though they do give a “moderate” rating to wedge insoles since they found some evidence that they helped.64

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RESOURCES: (We do not receive any financial gain from promoting these companies.)
Mountain Rose Herbs – Certified Organic Herbs, Spices, Oils, Extracts, and Supplements
https://www.mountainroseherbs.com/

Frontier Natural Foods CoOp – Natural and Organic Foods and Spices (not all organic)
http://www.frontiercoop.com/

MEGACOMfort Insoles – Podiatrist designed memory foam and gel layered insoles. The Insole Shop. http://www.insoleshop.com

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https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6249298/


45. **Collagen Types 1, 2, & 3 – Knowing the Important Differences.** Nutrients for an Energetic Lifestyle. [https://www.energeticnutrition.com/blog/2016/04/collagen-types-1-2-3-knowing-important-differences/](https://www.energeticnutrition.com/blog/2016/04/collagen-types-1-2-3-knowing-important-differences/)


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