



## Chondroitin sulfate

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*While some complementary and alternative techniques have been studied scientifically, high-quality data regarding safety, effectiveness, and mechanism of action are limited or controversial for most therapies. Whenever possible, it is recommended that practitioners be licensed by a recognized professional organization that adheres to clearly published standards. In addition, before starting a new technique or engaging a practitioner, it is recommended that patients speak with their primary healthcare provider(s). Potential benefits, risks (including financial costs), and alternatives should be carefully considered. The below monograph is designed to provide historical background and an overview of clinically-oriented research, and neither advocates for or against the use of a particular therapy.*

### Related Terms:

- ACS4-ACS6, ADAMTS7B, aggrecan, agrin, biglycan, biostat, CDS, chondroitin sulfate A, chondroitin sulfate C, chondroitin sulfate proteoglycan, chondroitin sulfates, chondroitin sulfuric acid, chondroitin sulphate, chondroitin sulphate A sodium, chondroitin-4-sulfate, chondroitin-6-sulfate, chondroitinase ABC, chondroprotective agents, chondrosine, chonsurid, CHST11, condroitin, Condrosulf®, Condrosulf 400®, CS, CS/DS, CSA, CSC, CSPG D-galactosamine, decorin, dentin sialoprotein, DexSol®, D-glucuronic acid, disease modifying osteoarthritis drugs, DMOAD, extended chondroitin sulfate/dermatan, fucosylated chondroitin sulfate, GAG, galactosaminoglucuronoglycan sulfate (Matrix®), glucosamine hydrochloride, glucosamine salts, glucosamine sulfate, glucosaminoglycan, Matrix®, neurocan, neuroglycan C, NGC, Optisol®, perineuronal nets, PNs, sodium chondroitin sulfate 0.2%, sodium chondroitin, Structum®, sulphate, symptomatic slow acting drug in osteoarthritis type XV, Syndecan, SYSADOA type XV, Uropol®-S, Viscoat®.

### BACKGROUND

- Chondroitin was first extracted and purified in the 1960s. It is currently manufactured from natural sources (shark/beef cartilage or bovine trachea) or by synthetic means. The consensus of expert and industry opinions supports the use of chondroitin and its common partner agent, glucosamine, for improving symptoms and stopping (or possibly reversing) the degenerative process of osteoarthritis.

### SCIENTIFIC EVIDENCE

<b>Uses</b> <i>These uses have been tested in humans or animals. Safety and effectiveness have not always been proven. Some of these conditions are potentially serious, and should be evaluated by a qualified healthcare provider.</i>	<b>Grade</b> <sup>*</sup>
<b><u>Osteoarthritis</u></b> Multiple controlled clinical trials since the 1980s have examined the use of oral chondroitin in patients with osteoarthritis of the knee and other locations (spine, hips, finger joints). Most of these studies have reported significant benefits in terms of symptoms (such as pain), function (such as mobility), and reduced medication	

<p>symptoms (such as pain), function (such as mobility), and reduced medication requirements (such as anti-inflammatories). However, most studies have been brief (six month duration) with methodological weaknesses. Despite these weaknesses and potential for bias in the available results, the weight of scientific evidence points to a beneficial effect when chondroitin is used for 6-24 months. Longer-term effects are not clear. Early studies of chondroitin applied to the skin have also been conducted.</p> <p>Chondroitin is frequently used with glucosamine. Glucosamine has independently been demonstrated to benefit patients with osteoarthritis (particularly of the knee). It remains unclear if there is added benefit of using these two agents together compared to using either alone.</p>	
<p><b><u>Bladder control</u></b></p> <p>Several studies have shown promise for using chondroitin for interstitial cystitis, which is a chronic inflammation of the bladder. Chondroitin sulfate may also be helpful in patients with overactive bladder or unstable bladder control. Additional evidence is necessary before a firm conclusion can be drawn.</p>	<b><u>B</u></b>
<p><b><u>Coronary artery disease (secondary prevention)</u></b></p> <p>Several studies in the early 1970s assessed the use of oral chondroitin for the prevention of subsequent coronary events in patients with a history of heart disease or heart attack. Although favorable results were reported, due to methodological weaknesses in this research and the widespread current availability of more proven drug therapies for patients in this setting, a recommendation cannot be made in this area.</p>	<b><u>C</u></b>
<p><b><u>Interstitial cystitis</u></b></p> <p>There is preliminary research administering intravesicular chondroitin in patients diagnosed with interstitial cystitis. Additional evidence is necessary before a firm conclusion can be drawn.</p>	<b><u>C</u></b>
<p><b><u>Iron absorption enhancement</u></b></p> <p>Early research suggests that taking chondroitin with iron may enhance iron absorption in healthy individuals. It is unclear whether taking chondroitin would help patients with iron deficiencies absorb more iron. More research needs to be done in this area before a strong recommendation can be made.</p>	<b><u>C</u></b>
<p><b><u>Ophthalmologic uses</u></b></p> <p>Chondroitin is sometimes used as a component of eye solutions used for keratoconjunctivitis, corneal preservation, and intraocular pressure. These solutions should only be used under the supervision of an ophthalmologist. Additional studies</p>	<b><u>C</u></b>

should only be used under the supervision of an ophthalmologist. Additional study is needed in this area.	
<b><u>Psoriasis</u></b> Early study suggests that chondroitin may help treat psoriasis. Well-designed clinical trials are needed to confirm these results.	<b><u>C</u></b>
<b><u>Muscle soreness (delayed onset)</u></b> Chondroitin was thought to be beneficial for delayed onset muscle soreness because chondroitin sulfate is often used as an anti-inflammatory and pain reliever for osteoarthritis. However, early research does not support this use. More research is needed in this area to confirm these results.	<b><u>D</u></b>
* <b>Key to grades:</b> <b>A:</b> Strong scientific evidence for this use; <b>B:</b> Good scientific evidence for this use; <b>C:</b> Unclear scientific evidence for this use; <b>D:</b> Fair scientific evidence against this use (it may not work); <b>F:</b> Strong scientific evidence against this use (it likely does not work).	

## TRADITION/THEORY

The below uses are based on tradition, scientific theories, or limited research. They often have not been thoroughly tested in humans, and safety and effectiveness have not always been proven. Some of these conditions are potentially serious, and should be evaluated by a qualified healthcare provider. There may be other proposed uses that are not listed below.

- Aging, allergies, Alzheimer's disease, analgesic, angina (chest pain), anticoagulant (blood thinner), anti-inflammatory, antioxidant, antithrombotic, atherosclerosis, bone healing, breast cancer, cardiovascular health, chronic venous ulcers, deep intra-osseous defects, gonarthrosis, gum disease, headaches, heart attack (treatment and prevention), high cholesterol, HIV/AIDS, hyperglycemia/diabetes, iron deficiency anemia, joint pain, joint problems (cartilage repair, disc degeneration, synovial fluid productions), kidney stones, leukemia, malaria, nerve regeneration, osteoporosis, premature birth prevention, respiratory ailments, rheumatoid arthritis, snoring, soft tissue injury (torn ligaments and tendons), spinal cord injury, sports injuries, venous leg ulcers, wound healing.

## DOSING

The below doses are based on scientific research, publications, traditional use, or expert opinion. Many herbs and supplements have not been thoroughly tested, and safety and effectiveness may not be proven. Brands may be made differently, with variable ingredients, even within the same brand. The below doses may not apply to all products. You should read product labels, and discuss doses with a qualified healthcare provider before starting therapy.

### Adult (18 years and older)

- Doses of 200-400 milligrams by mouth twice to three times daily, or 800-1,200 milligrams once daily have been used in studies. Higher doses (up to 2,000 milligrams) appear to have similar efficacy. In the treatment of osteoarthritis, full effects may take several weeks to occur.

- It is not clear what dose is optimal when used in combination with glucosamine or whether the combination is as effective as or more effective than either agent alone.
- For osteoarthritis, 50-100 milligrams as a single daily injection or divided into two daily injections has been used. Medical supervision is recommended.

### Children (younger than 18 years)

- There is no proven effective dose for chondroitin in children.

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## SAFETY

*The U.S. Food and Drug Administration does not strictly regulate herbs and supplements. There is no guarantee of strength, purity or safety of products, and effects may vary. You should always read product labels. If you have a medical condition, or are taking other drugs, herbs, or supplements, you should speak with a qualified healthcare provider before starting a new therapy. Consult a healthcare provider immediately if you experience side effects.*

### Allergies

- Use cautiously if allergic or hypersensitive to chondroitin sulfate products. Use cautiously in patients with shellfish allergy, due to the possibility of allergic reaction. Hives, rash, sun skin sensitivity, and worsening of previously well-controlled asthma have been reported.

### Side Effects and Warnings

- Chondroitin sulfate appears to be well tolerated for up to three years.
- Adverse effects that have been rarely reported or are theoretical include: headache, motor uneasiness, euphoria, hives, rash, photosensitivity, hair loss, breathing difficulties, subjective tightness in the throat or chest, exacerbation of previously well-controlled asthma, chest pain, elevated blood pressure, lower extremity edema, gastrointestinal pain/dyspepsia, nausea, diarrhea, constipation, transaminitis, increased risk of bleeding (theoretical), bone marrow suppression (animal research), and eyelid edema.
- Avoid in individuals with prostate cancer, or at increased risk for prostate cancer, due to a risk of increased spread or recurrence of prostate cancer.

### Pregnancy and Breastfeeding

- Avoid in pregnant or breastfeeding women as effects are unknown, and there is structural similarity to heparin, a blood thinner that is contraindicated during pregnancy.

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## INTERACTIONS

*Most herbs and supplements have not been thoroughly tested for interactions with other herbs, supplements, drugs, or foods. The interactions listed below are based on reports in scientific publications, laboratory experiments, or traditional use. You should always read product labels. If you have a medical condition, or are taking other drugs, herbs, or supplements, you should speak with a qualified healthcare provider before starting a new therapy.*

### Interactions with Drugs

- In theory, chondroitin may increase the risk of bleeding when taken with drugs that increase the risk of bleeding. Some examples include aspirin, anticoagulants ("blood thinners") such as warfarin (Coumadin®) or heparin, anti-platelet drugs such as clopidogrel (Plavix®), and non-steroidal anti-inflammatory drugs such as ibuprofen (Motrin®, Advil®) or naproxen (Naprosyn®, Aleve®).

- Use cautiously with hyaluronidase or agents with hydrophilic (attraction to water) properties. Consult with a qualified healthcare professional, including a pharmacist, to check for interactions.
- Also use cautiously when combining chondroitin with other agents that may cause sun sensitivity, as chondroitin may increase sun sensitivity.

### Interactions with Herbs and Dietary Supplements

- In theory, chondroitin may increase the risk of bleeding when taken with herbs and supplements that are believed to increase the risk of bleeding. Multiple cases of bleeding have been reported with the use of *Ginkgo biloba*, and fewer cases with garlic and saw palmetto. Numerous other agents may theoretically increase the risk of bleeding, although this has not been proven in most cases.
- Based on preliminary data, chondroitin may increase iron absorption. It may also interact with or alter concentrations of calcium, camphor, glucosamine, manganese, peppermint oil, and shark cartilage.
- Use cautiously with herbs or supplements with hydrophilic (attraction to water) properties. Consult with a qualified healthcare professional, including a pharmacist, to check for interactions. Also use cautiously when combining chondroitin with other agents that may cause sun sensitivity, as chondroitin may increase sun sensitivity.

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### AUTHOR INFORMATION

- This information is based on a systematic review of scientific literature edited and peer-reviewed by contributors to the Natural Standard Research Collaboration ([www.naturalstandard.com](http://www.naturalstandard.com)).

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### REFERENCES

*Natural Standard developed the above evidence-based information based on a thorough systematic review of the available scientific articles. For comprehensive information about alternative and complementary therapies on the professional level, go to [www.naturalstandard.com](http://www.naturalstandard.com). Selected references are listed below.*

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