What Are Kidney Stones?
As the stone grows larger it may detach, floating into the larger renal pelvis and down the urethra. It can cause its blockage resulting in a painful ‘attack’.

Detachment of a stone does not depend on its size.

Some stones do not detach and may continue to grow until they fill the entire kidney.
Types of kidney stones: mineral salts

- Calcium phosphate often associated with urinary tract infections, alkaline urine.

These types of stones represent:
- 8-18% stones in adults (75% in pregnant women) and 24-30% in children.

- Struvite (magnesium ammonium phosphate) promoted in alkaline urine, high phosphate intake. They represent:
  - 2-4% stones in adults and 7-13% in children.
Kidney stones: mixed types
Calcium oxalate

Oxalic Acid.
Black spheres are Carbon, red Oxygen, white Hydrogen

Most frequent type of kidney stones found in:
• 56-61% stones in adults,
• 45-65% in children

Dr. Rath Research Institute; 2013
**Kidney stones: organic molecules**

- **Uric acid** stones in people with gout (vit. C reduces risk), inadequate purine metabolism, high protein diet, diabetes. Citrate keeps pH around 6 optimal for solubilizing the stones. This type of kidney stone is found in 9-17% of stones that develop in adults and 2-4% in children.

- **Cystine** stones in patients with a genetic disorder – cystinuria - defective reabsorption of amino acids. Cystine is more soluble in alkaline urine. Prevalence: 1% of stones in adults, 5-8% in children.
Who is prone to developing kidney stones?

- Caucasians
- Men (in their 40s)
- Women (in their 50s)
- Pregnancy (3x higher risk of calcium phosphate stones than oxalate)
- Increased risk in young people (in their 20’s) compared to 1975
  - 13% of males vs 4.4%
  - 19.6% females vs 4%
More about Calcium Oxalate and Kidney Stones
Sources of Oxalate in Our Body

- **INTESTINES**
  - Oxalate in Food
  - Excretion in Feces
- **BLOOD**
  - Oxalate
  - Secretion
  - Absorption
  - Vitamin C
  - Yeast overgrowth (Aspergillus)
- **LIVER**
  - Glyoxalate
  - Vitamin B6
  - Oxalate

Accumulation in tissues (bones, brain, muscles, eyes, other organs)

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Foods rich in oxalate

Beets  950mg/100g
Spinach  790mg/100g
Rhubarb  450mg/100g
Chocolates  150-485mg/100g
Cocoa  620mg/100g

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Oxalate intestinal absorption depends on many factors: calcium.

Average daily intake of oxalate is about 200mg. High intake is 1000-2000mg.

Diet Type | Oxalate absorption
--- | ---
Low Calcium | High Calcium
Low in oxalate (10mg) | 28% | 24%
Higher in oxalate (250mg) | 52% | 41%

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Other factors affecting oxalate intestinal absorption

Phytates – bind minerals thereby increasing intestinal absorption of oxalate. However, they are beneficial in solubilizing oxalate in urine.

Fat malabsorption – decreases intestinal calcium promoting higher absorption of oxalate.

Lipid lowering drugs (i.e. Zetia) increase oxalate in urine.

Antibiotics interfere with oxalate metabolism by intestinal bacteria. Supplementation with *Oxalobacter* in healthy individuals and hyperoxaluria patients resulted in a decrease of urinary oxalate by up to 90%.
Sources of oxalate in blood plasma and urine

Vitamin C metabolism
- 1.5% of intake

Absorbed from intestine
- 10-60% ingested

Glyoxalate metabolism
- (90mg/day)
  - All synthesized oxalate is absorbed

Blood plasma oxalate:
large variations depending on the measurement method.
Average values: 270 mcg/l

Oxalate in urine:
Normal: 20-50mg/day
Secondary HO: <90mg/d
Primary HO: >90mg/d
Factors affecting oxalate stone formation in urine

Fluid intake – (optimum 2-3 l/day)

Citrate and Magnesium – increase solubility of oxalate

Phytates – beneficial in solubilizing oxalate in urine

Glycosaminoglycans – prevent oxalate crystal growth

Natural chelators in urine (i.e. calcium binding proteins, uropontin, nefrocalcin, other)

Vitamin C can solubilize calcium oxalate stones (chelation effect)
Vitamin C metabolism and oxalate

Ascorbic Acid

- Oxygen
- GSH

Dehydro-Ascorbic Acid

Diketogulonic acid

- OXALIC ACID

Threosone

Erythulose

OXALIC ACID

Only about 1.5% of ingested vitamin C converted to oxalate \textit{in vivo}\n
Study in stone-formers reported that intake of 1g of vitamin C contributed to only 0.65% increase in oxalate secretion. This intake of vitamin C in non-stone-formers resulted in a slight decrease in secreted oxalate.

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Vitamin C and oxalate secretion: no consistent results

- **Technical issues**: Oxalate measurements in urine often affected by errors (i.e. due to storage).
- **High vitamin C intake not related to oxalate levels**:
  - study in healthy volunteers consuming 3-10g vitamin C for 2 years: no significant differences in urine oxalate compared to non-consumers.
  - 10g vitamin C a day: elevated oxalate in 1 our of 6 volunteers but within the range observed in high oxalate diet.
  - 4g vitamin C for 5 days: no effect on oxalate.
Vitamin C and oxalate secretion: no consistent results

• No uniform response: Ingestion of 2g of vitamin C for 5 days in 29 stone-formers and 19 non-stone-formers resulted in an increase of oxalate by over 10% only in 12 stone-formers and 7 non-stone formers. Stones were not analyzed.

• Reverse dose dependency: Lower increase in oxalate secretion with higher vitamin C intake; i.e. stone-formers consuming 2g of vitamin C had oxalate increase by 41%, which was less than stone formers (61%) and in non-stone-formers (56%) taking 1g of vitamin C.
Clinical studies: no connection between vitamin C and kidney stones

- Epidemiological studies do not support causative effect of vitamin C intake on kidney stones:
  - 85,557 women followed for 14 years (1078 kidney stones cases).
  - Vitamin C and vitamin B6 intake associated with lower incidence of kidney stones.
  - Decrease in kidney stones with intake of >1.5g vitamin C a day compared to <250mg/day.
- Conclusion: “restriction of vitamin C to prevent stone formation appears unwarranted.”

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No connection between vitamin C and kidney stones re-evaluated (?)

– Study in 45,619 men (40-75 years old) for 6 years (751 incidence of kidney stones).

– Age adjusted relative risk of developing kidney stones was 22% lower in a group consuming >1500mg of vitamin C than <250mg.

– Re-evaluation of this study pointed to a symptomatic link between Vitamin C intake (1000mg) and kidney stones.

1996
Media eagerly publicize such results

Study on 23,355 men (av. 59 years old) in Sweden implied that vitamin C intake can be linked to higher incidence of kidney stones:

- Only 907 men took vitamin C and after 11 years only 27 of them had developed kidney stones (3%)
- 22,000 men did not take vitamin C (2% developed kidney stones)
- No verification of vitamin C doses taken
- No verification of type of kidney stones
- No control for dehydration, use of diuretics, detail diet composition, other
- Overall kidney stones incidence was low compared to average population (about 5%-10%)

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Common issues with studies on vitamin C and kidney stones

- Observational / poorly controlled
- Low kidney stone incidents prone to statistical errors
- No measurement of kidney stones types, progression or formation
- Technical issues with sample (urine) storage
- Insufficient understanding of metabolic aspects involved in oxalate metabolism, transport and specific issues involved in kidney stone formation
- Hasty or unsubstantiated conclusions
Natural Health Education: Use this powerful tool to protect your health from becoming a victim of myths and organized fear.