Holladay Physical Medicine
4211 Holladay Blvd. – Holladay, UT 84124 – (801) 272-8471
Bruce Gundersen, D.C., DIANM
www.holladayphysicalmedicine.com

This Information is about this condition in general. Every individual has a unique presentation. Once you understand this information, consult the doctor on any specific questions about your condition.

Kidney Stones

A kidney stone, also known as a renal calculus (from the Latin *ren*, "kidney" and *calculus*, "pebble") is a solid concretion or crystal aggregation formed in the kidneys from dietary minerals in the urine.

Urinary stones are typically classified by their location in the kidney (nephrolithiasis), ureter (ureterolithiasis), or bladder (cystolithiasis), or by their chemical composition (calcium-containing, struvite, uric acid, or other compounds). About 80% of those with kidney stones are men. Men most commonly experience their first episode between 30 and 40 years of age, while for women the age at first presentation is somewhat later.

Kidney stones typically leave the body by passage in the urine stream, and many stones are formed and passed without causing symptoms. If stones grow to sufficient size (usually at least 3 millimeters (0.12 in)) they can cause obstruction of the ureter. Ureteral obstruction causes postrenal azotemia and hydronephrosis (distension and dilation of the renal pelvis and calyces), as well as spasm of the ureter. This leads to pain, most commonly felt in the flank (the area between the ribs and hip), lower abdomen, and groin (a condition called renal colic). Renal colic can be associated with nausea, vomiting, fever, blood in the urine, pus in the urine, and painful urination. Renal colic typically comes in waves lasting 20 to 60 minutes, beginning in the flank or lower back and often radiating to the groin or genitals. The diagnosis of kidney stones is made on the basis of information obtained from the history, physical examination, urinalysis, and radiographic studies. Ultrasound examination and blood tests may also aid in the diagnosis.

When a stone causes no symptoms, watchful waiting is a valid option. For symptomatic stones, pain control is usually the first measure, using medications such as nonsteroidal anti-inflammatory drugs or opioids. More severe cases may require surgical intervention. For example, some stones can be shattered into smaller fragments using extracorporeal shock wave lithotripsy. Some cases require more invasive forms of surgery. Examples of these are cystoscopic procedures such as laser lithotripsy or percutaneous techniques such as percutaneous nephrolithotomy. Sometimes, a tube (ureteral stent) may be placed in the ureter to bypass the obstruction and alleviate the symptoms, as well as to prevent ureteral stricture after ureteroscopic stone removal.

Signs and Symptoms

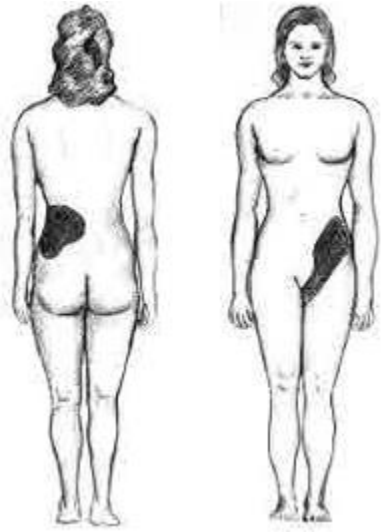


Diagram showing the typical location of renal colic, below the rib cage to just above the pelvis

The hallmark of stones that obstruct the ureter or renal pelvis is excruciating, intermittent pain that radiates from the flank to the groin or to the genital area and inner thigh.[1] This particular type of pain, known as renal colic, is often described as one of the strongest pain sensations known.[2] Renal colic caused by kidney stones is commonly accompanied by urinary urgency, restlessness, hematuria, sweating, nausea, and vomiting. It typically comes in waves lasting 20 to 60 minutes caused by peristaltic contractions of the ureter as it attempts to expel the stone.[1] The embryological link between the urinary tract, the genital system, and the gastrointestinal tract is the basis of the radiation of pain to the gonads, as well as the nausea and vomiting that are also common in urolithiasis.[3] Postrenal azotemia and hydronephrosis can be observed following the obstruction of urine flow through one or both ureters.[4]

Causes

Dietary factors that increase the risk of stone formation include low fluid intake and high dietary intake of animal protein, sodium, refined sugars, fructose and high fructose corn syrup, oxalate, grapefruit juice, apple juice, and cola drinks.

X-ray with bilateral kidney stones

Calcium

Calcium is one component of the most common type of human kidney stones, calcium oxalate. Some studies suggest people who take supplemental calcium have a higher risk of developing kidney stones, and these findings have been used as the basis for setting the recommended daily intake for calcium in adults.[7] In the Women's Health Initiative, postmenopausal women who consumed 1000 mg of supplemental calcium and 400 international units of vitamin D per day for seven years had a 17% higher risk of developing kidney stones than subjects taking a placebo.[8] The Nurses' Health Study also showed an association between supplemental calcium intake and kidney stone formation.[6]

Unlike supplemental calcium, high intakes of dietary calcium do not appear to cause kidney stones and may actually protect against their development.[6][8] This is perhaps related to the role of calcium in binding ingested oxalate in the gastrointestinal tract. As the amount of calcium intake decreases, the amount of oxalate available for absorption into the bloodstream increases; this oxalate is then excreted in greater amounts into the urine by the kidneys. In the urine, oxalate is a very strong promoter of calcium oxalate precipitation, about 15 times stronger than calcium. In fact, current evidence suggests the consumption of diets low in calcium is associated with a higher overall risk for the development of kidney stones.[9] For most individuals, however, other risk factors for kidney stones, such as high intakes of dietary oxalates and low fluid intake, probably play a greater role than calcium intake.[10]

Other electrolytes

Aside from calcium, other electrolytes appear to influence the formation of kidney stones. For example, by increasing urinary calcium excretion, high dietary sodium may increase the risk of stone formation.[6] Fluoridation of drinking water may increase the risk of kidney stone formation by a similar mechanism, though further epidemiologic studies are warranted to determine whether fluoride in drinking water is associated with an increased incidence of kidney

stones.[11] On the other hand, high dietary intake of potassium appears to reduce the risk of stone formation because potassium promotes the urinary excretion of citrate, an inhibitor of urinary crystal formation. High dietary intake of magnesium also appears to reduce the risk of stone formation somewhat, because like citrate, magnesium is also an inhibitor of urinary crystal formation.[6]

Animal protein

Diets in Western nations typically contain more animal protein than the body needs.[12] Urinary excretion of excess sulfurous amino acids (e.g., cysteine and methionine), uric acid and other acidic metabolites from animal protein acidifies the urine, which promotes the formation of kidney stones.[*citation needed*] The body often balances this acidic urinary pH by leaching calcium from the bones, which further promotes the formation of kidney stones. Low urinary citrate excretion is also commonly found in those with a high dietary intake of animal protein, whereas vegetarians tend to have higher levels of citrate excretion.[6]

Vitamins

Despite a widely held belief in the medical community that ingestion of vitamin C supplements is associated with an increased incidence of kidney stones,[13] the evidence for a causal relationship between vitamin C supplements and kidney stones is inconclusive. While excess dietary intake of vitamin C might increase the risk of calcium oxalate stone formation, in practice this is rarely encountered. The link between vitamin D intake and kidney stones is also tenuous. Excessive vitamin D supplementation may increase the risk of stone formation by increasing the intestinal absorption of calcium, but there is no evidence that correction of vitamin D deficiency increases the risk of stone formation.[6]

Other

There are no conclusive data demonstrating a cause-and-effect relationship between alcohol consumption and kidney stones. However, some have theorized that certain behaviors associated with frequent and binge drinking can lead to systemic dehydration, which can in turn lead to the development of kidney stones.[14] The American Urological Association has projected that increasing global temperatures will lead to an increased incidence of kidney stones in the United States by expanding the "kidney stone belt" of the southern United States.[15]

Pathophysiology

Supersaturation of urine

When the urine becomes supersaturated (when the urine solvent contains more solutes than it can hold in solution) with one or more calculogenic (crystal-forming) substances, a seed crystal may form through the process of nucleation.[16] Heterogeneous nucleation (where there is a solid surface present on which a crystal can grow) proceeds more rapidly than homogeneous nucleation (where a crystal must grow in liquid medium with no such surface), because it

requires less energy. Adhering to cells on the surface of a renal papilla, a seed crystal can grow and aggregate into an organized mass. Depending on the chemical composition of the crystal, the stone-forming process may proceed more rapidly when the urine pH is unusually high or low.[17]

Supersaturation of the urine with respect to a calculogenic compound is pH-dependent. For example, at a pH of 7.0, the solubility of uric acid in urine is 158 mg/100 ml. Reducing the pH to 5.0 decreases the solubility of uric acid to less than 8 mg/100 ml. The formation of uric acid stones requires a combination of hyperuricosuria (high urine uric acid levels) and low urine pH; hyperuricosuria alone is not associated with uric acid stone formation if the urine pH is alkaline.[18] Supersaturation of the urine is a necessary, but not a sufficient, condition for the development of any urinary calculus.[16] Supersaturation is likely the underlying cause of uric acid and cystine stones, but calcium-based stones (especially calcium oxalate stones) may have a more complex etiology.[19]

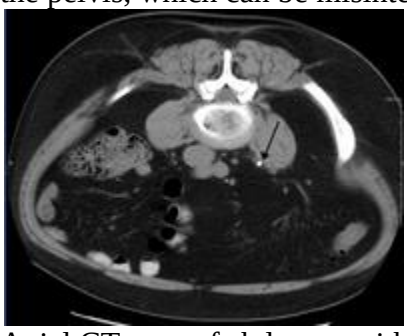
Inhibitors of stone formation

Normal urine contains chelating agents, such as citrate, that inhibit the nucleation, growth, and aggregation of calcium-containing crystals. Other endogenous inhibitors include calgranulin (an S-100 calcium binding protein), Tamm-Horsfall protein, glycosaminoglycans, uropontin (a form of osteopontin), nephrocalcin (an acidic glycoprotein), prothrombin F1 peptide, and bikunin (uronic acid-rich protein). The biochemical mechanisms of action of these substances have not yet been thoroughly elucidated. However, when these substances fall below their normal proportions, stones can form from an aggregation of crystals.[20]

Kidney stones often result from a combination of factors, rather than a single, well-defined cause. Stones are more common in people whose diet is very high in animal protein or who do not consume enough water or calcium.[1] They can result from an underlying metabolic condition, such as distal renal tubular acidosis,[21] Dent's disease,[22] hyperparathyroidism,[23] primary hyperoxaluria[24] or medullary sponge kidney. In fact, studies show about 3% to 20% of people who form kidney stones have medullary sponge kidney.[16][25] Kidney stones are also more common in people with Crohn's disease.[26] People with recurrent kidney stones are often screened for these disorders. This is typically done with a 24-hour urine collection that is chemically analyzed for deficiencies and excesses that promote stone formation.[4]

Diagnosis


Bilateral kidney stones can be seen on this KUB radiograph. Note the presence of phleboliths in the pelvis, which can be misinterpreted as bladder stones.


Axial CT scan of abdomen without contrast, showing a 3-mm stone (marked by an arrow) in the left proximal ureter


A stone at the uteral vesicular junction

Diagnosis of kidney stones is made on the basis of information obtained from the history, physical examination, urinalysis, and radiographic studies.[27] Clinical diagnosis is usually made on the basis of the location and severity of the pain, which is typically colicky in nature (comes and goes in spasmodic waves). Pain in the back occurs when calculi produce an obstruction in the kidney.[28] Physical examination may reveal fever and tenderness at the costovertebral angle on the affected side.[27]

Imaging studies

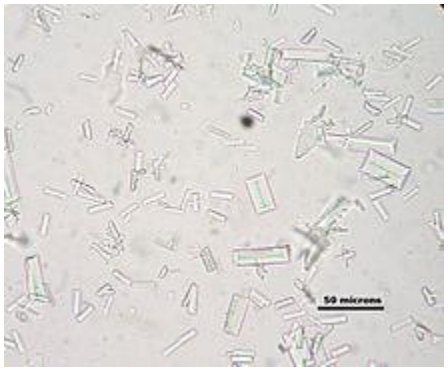
Calcium-containing stones are relatively radiodense, and they can often be detected by a traditional radiograph of the abdomen that includes the kidneys, ureters, and bladder (KUB film).[29] Some 60% of all renal stones are radiopaque.[30][31] In general, calcium phosphate stones have the greatest density, followed by calcium oxalate and magnesium ammonium phosphate stones. Cystine calculi are only faintly radiodense, while uric acid stones are usually entirely radiolucent.[32]

Where available, a noncontrast helical CT scan with 5 millimeters (0.20 in) sections is the diagnostic modality of choice in the radiographic evaluation of suspected nephrolithiasis.[3][27][30][33][34] All stones are detectable on CT scans except very rare stones composed of certain drug residues in the urine,[29] such as from indinavir.

Where a CT scan is unavailable, an intravenous pyelogram may be performed to help confirm the diagnosis of urolithiasis. This involves intravenous injection of a contrast agent followed by a KUB film. Uroliths present in the kidneys, ureters or bladder may be better defined by the use of this contrast agent. Stones can also be detected by a retrograde pyelogram, where a similar contrast agent is injected directly into the distal ostium of the ureter (where the ureter terminates as it enters the bladder).[30]

Ultrasound imaging of the kidneys can sometimes be useful, as it gives details about the presence of hydronephrosis, suggesting the stone is blocking the outflow of urine.[29] Radiolucent stones, which do not appear on CT scans, may show up on ultrasound imaging studies. Other advantages of renal ultrasonography include its low cost and absence of radiation exposure. Ultrasound imaging is useful for detecting stones in situations where X-rays or CT scans are discouraged, such as in children or pregnant women.[35] Despite these advantages, renal ultrasonography is not currently considered a substitute for noncontrast helical CT scan in the initial diagnostic evaluation of urolithiasis.[33] The main reason for this is that compared with CT, renal ultrasonography more often fails to detect small stones (especially ureteral stones), as well as other serious disorders that could be causing the symptoms.[1]

Laboratory examination



Struvite crystals found on microscopic examination of the urine

Laboratory investigations typically carried out include:

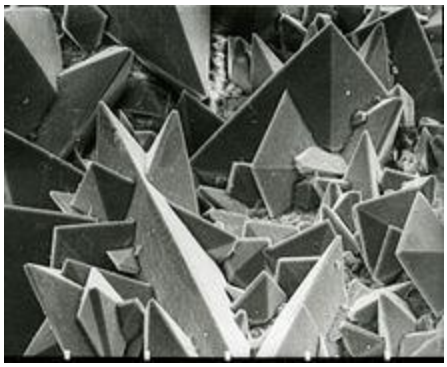
- microscopic examination of the urine, which may show red blood cells, bacteria, leukocytes, urinary casts and crystals;
- urine culture to identify any infecting organisms present in the urinary tract and sensitivity to determine the susceptibility of these organisms to specific antibiotics;
- complete blood count, looking for neutrophilia (increased neutrophil granulocyte count) suggestive of bacterial infection, as seen in the setting of struvite stones;
- renal function tests to look for abnormally high blood calcium blood levels (hypercalcemia);
- 24 hour urine collection to measure total daily urinary volume, magnesium, sodium, uric acid, calcium, citrate, oxalate and phosphate;
- collection of stones (by urinating through a StoneScreen kidney stone collection cup or a simple tea strainer) is useful. Chemical analysis of collected stones can establish their composition, which in turn can help to guide future preventive and therapeutic management.

Classification

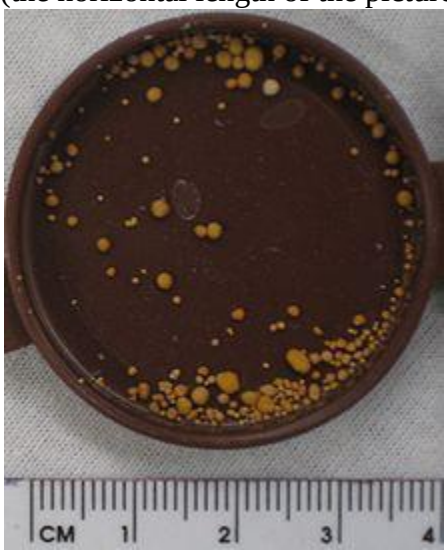
Kidney stones are typically classified by their location and chemical composition.

Kidney Stone type	Population	Circumstances	Details
Calcium oxalate	80%	when urine is acidic (low pH)	Some of the oxalate in urine is produced by the body. Calcium and oxalate in the diet play a part but are not the only factors that affect the formation of calcium oxalate stones. Dietary oxalate is an organic molecule found in many vegetables, fruits, and nuts. Calcium from bone may also play a role in kidney stone formation.
Calcium phosphate	___%	when urine is alkaline (high pH)	
Uric acid	5-10%	when urine is persistently acidic	Diets rich in animal proteins and purines: substances found naturally in all food but especially in organ meats, fish, and shellfish.
Struvite	10-15%	infections in the kidney	Preventing struvite stones depends on staying infection-free. Diet has not been shown to affect struvite stone formation.
Cystine	___%	rare genetic disorder	Cystine, an amino acid (one of the building blocks of protein), leaks through the kidneys and into the urine to form crystals.

Chemical composition



Scanning electron micrograph of the surface of a kidney stone showing tetragonal crystals of Weddellite (calcium oxalate dihydrate) emerging from the amorphous central part of the stone (the horizontal length of the picture represents 0.5 mm of the figured original)



Multiple kidney stones composed of uric acid and a small amount of calcium oxalate

Calcium-containing stones

By far, the most common type of kidney stones worldwide contains calcium. For example, calcium-containing stones represent about 80% of all cases in the United States; these typically contain calcium oxalate either alone or in combination with calcium phosphate in the form of apatite or brushite.[16][20] Factors that promote the precipitation of oxalate crystals in the urine, such as primary hyperoxaluria, are associated with the development of calcium oxalate stones.[24] The formation of calcium phosphate stones is associated with conditions such as hyperparathyroidism[23] and renal tubular acidosis.[37]

Struvite stones

About 10–15% of urinary calculi are composed of struvite (ammonium magnesium phosphate, $NH_4MgPO_4 \cdot 6H_2O$).[38] Struvite stones (also known as "infection stones", urease or triple-phosphate stones), form most often in the presence of infection by urea-splitting bacteria. Using

the enzyme urease, these organisms metabolize urea into ammonia and carbon dioxide. This alkalinizes the urine, resulting in favorable conditions for the formation of struvite stones. *Proteus mirabilis*, *Proteus vulgaris*, and *Morganella morganii* are the most common organisms isolated; less common organisms include *Ureaplasma urealyticum*, and some species of *Providencia*, *Klebsiella*, *Serratia*, and *Enterobacter*. These infection stones are commonly observed in people who have factors that predispose them to urinary tract infections, such as those with spinal cord injury and other forms of neurogenic bladder, ileal conduit urinary diversion, vesicoureteral reflux, and obstructive uropathies. They are also commonly seen in people with underlying metabolic disorders, such as idiopathic hypercalciuria, hyperparathyroidism, and gout. Infection stones can grow rapidly, forming large calyceal staghorn (antler-shaped) calculi requiring invasive surgery such as percutaneous nephrolithotomy for definitive treatment.[38]

Uric acid stones

About 5–10% of all stones are formed from uric acid.[21] People with certain metabolic abnormalities, including obesity,[6] may produce uric acid stones. They also may form in association with conditions that cause hyperuricosuria (an excessive amount of uric acid in the urine) with or without hyperuricemia (an excessive amount of uric acid in the serum). They may also form in association with disorders of acid/base metabolism where the urine is excessively acidic (low pH), resulting in precipitation of uric acid crystals. A diagnosis of uric acid urolithiasis is supported by the presence of a radiolucent stone in the face of persistent urine acidity, in conjunction with the finding of uric acid crystals in fresh urine samples.[39]

Other types

People with certain rare inborn errors of metabolism have a propensity to accumulate crystal-forming substances in their urine. For example, those with cystinuria, cystinosis, and Fanconi syndrome may form stones composed of cystine. People afflicted with xanthinuria often produce stones composed of xanthine. People afflicted with adenine phosphoribosyltransferase deficiency may produce 2,8-dihydroxyadenine stones,[40] alkaptonurics produce homogentisic acid stones, and iminoglycinurics produce stones of glycine, proline and hydroxyproline.[41][42] Urolithiasis has also been noted to occur in the setting of therapeutic drug use, with crystals of drug forming within the renal tract in some people currently being treated with agents such as indinavir,[43] sulfadiazine[44] and triamterene.[45]

Location

This radiograph shows a large staghorn calculus involving the major calyces and renal pelvis in a person with severe scoliosis. Struvite stones can grow rapidly, forming large calyceal staghorn calculi that can require invasive surgery such as percutaneous nephrolithotomy or even anatrophic nephrolithotomy for definitive treatment.

Urolithiasis refers to stones originating anywhere in the urinary system, including the kidneys and bladder.[3] Nephrolithiasis (from the Greek νεφρός (*nephros*, "kidney") and λίθος (*lithos*, "stone")) refers to the presence of such calculi in the kidneys. Calyceal calculi refers to aggregations in either the minor or major calyx, parts of the kidney that pass urine into the ureter (the tube connecting the kidneys to the urinary bladder). The condition is called ureterolithiasis when a calculus is located in the ureter. Stones may also form or pass into the bladder, a condition referred to as cystolithiasis.

PREMISE

In order to recover from many of today's chronic health disorders, a basic premise must be understood on which all other treatments and remedies depend. The body must be fed the proper ingredients to heal and it must not be fed or exposed to harmful or toxic elements. Go to our web page www.holladayphysicalmedicine.com Scroll down to the Absolute Health Clinic on the right and click on Learn More. Review each of the following completely: Things to Avoid or Eliminate, Things to Do, Detoxification, Preferred Foods, Forbidden Foods, and Cleaning Products Substitutes.

Each of these items is necessary for you to overcome this disorder. It is not likely that a cure is readily achievable and management is our initial goal. Depending on how long your body has suffered from this disorder, it may take at least half that long to gain control of the condition and manage it in such a way as to not completely interfere with your daily routine. Expectations should be largely based on your individual history with this condition.

USE OF PRESCRIPTION DRUGS

We do not prescribe drugs nor recommend their use if harmful side-effects are associated with your complaints. We also do not, in any case, recommend changes in the use of prescription drugs that a licensed physician has given you. If you believe alterations in those prescriptions are in the best interest of your health, always consult with the prescribing physician before making any changes.

SUPPLEMENTATION:

The ideal situation for nutrition in any injury or disease is first to eat whole foods, and to avoid processed foods, fast foods preservatives, refined carbohydrates and sugar. We have much information on our web page under Absolute Health Clinic. The physical medicine modalities we will provide you will help reduce the symptoms in the time we have projected. If you want to heal, this step is something you will need to take.

Nowadays, even if you do all of those things, you need to realize that our food supply has been gradually depleted. The pure ingredients needed to maintain body function, metabolism and immunity have been drastically reduced. We recommend only whole food supplements. Studies are clear that synthetic vitamins and mineral supplements are not only not helpful to the body in most cases, but can toxic. Don't expect them to take the place of what we recommend here. They will not help you sufficiently to heal properly. The following list has been prioritized to help you gradually begin to supplement your improved diet and provide your body with the ingredients it needs to restore or improve your immune response and then provide the raw materials in usable form to repair the damaged or diseased tissue. The degree to which you can implement these items will largely determine how fast you recover and more importantly whether or not you have a recurrence or relapse of the symptoms again soon.

These products are all produced by Standard Process. You may obtain them on line from Amazon or other distributors if you like or we can order them for you and save you an average of $5 per bottle plus you can avoid shipping charges.

GENERAL DAILY SUPPLEMENTS

- Catalyn
- Tuna Omega-3 oil
- Calcium Lactate
- Trace Minerals B12
- Cataplex D
- Prolamine Iodine

SPECIFIC FOR THIS CONDITION

- Phosfood
- Arginex
- Cataplex ACP
- Magnesium Lactate
- Renatrophin
- Corn silk
- Horse Tail

Specific dosages will be provided by the doctor.

We have many other specific items for a variety of health deficient conditions. Consult our web page or ask the doctor.

EXERCISE

Begin a daily walking routine of 1 minute on the first day. Add 1 minute each day until you are at 45 minutes of continuous walking. Make this a specific time and walking around stores, work or home does not count.

MAINTENANCE:

Regular spinal adjustments and mild forms of physical therapy are important to reduce the symptoms on a regular basis. Patients who receive monthly spinal manipulation and therapy report fewer complications and improved life style. It is important that you follow your chiropractic physician's advice about the frequency of treatment for your particular condition.

OTHER INFORMATION:

We offer a wide variety of health information at our web site. www.holladayphysicalmedicine.com All patients are welcome to use our information to improve your life and maintain your spinal health.

This information is provided to you as a health service by Dr. Bruce Gundersen, DC, DIANM. He is board certified by the International Academy of Neuromusculoskeletal Medicine and currently serves as chairman of the examination board for the Academy. He is also the President of the Utah College of Chiropractic Orthopedists and clinical director and chief clinician at Holladay Physical Medicine. He has practiced physical and regenerative medicine for over 40 years.