

Overview

Useful For

Monitoring metallic prosthetic implant wear and local tissue destruction in failed hip arthroplasty constructs

This test is **not useful for** assessment of vitamin B12 activity.

Profile Information

Test ID	Reporting Name	Available Separately	Always Performed
CRSY	Chromium, Synovial FI	Yes	Yes
COSY	Cobalt, Synovial FI	Yes	Yes

Special Instructions

- [Trace Metals Analysis Specimen Collection and Transport](#)

Method Name

Inductively Coupled Plasma-Mass Spectrometry (ICP-MS)

NY State Available

Yes

Specimen

Specimen Type

Synovial Fluid

Ordering Guidance

This test should only be used in individuals with chromium or cobalt implants.

Specimen Required

Patient Preparation: High concentrations of gadolinium and iodine are known to interfere with most metals tests. If either gadolinium- or iodine-containing contrast media has been administered, a specimen should not be collected for at least 96 hours

Supplies: Metal Free B-D Tube (EDTA), 6 mL (T183)

Container/Tube: Royal blue top (metal-free EDTA)

Specimen Volume: 1 mL

Collection Instructions: See [Trace Metals Analysis Specimen Collection and Transport](#) in Special Instructions for complete instructions.

Additional Information: Cobalt and chromium are present in the black rubber plunger seals found in most disposable syringes. As a result, synovial fluid should not be collected in these devices as contamination may occur.

Specimen Minimum Volume

0.4 mL

Reject Due To

Gross hemolysis	OK
Gross lipemia	OK
Gross icterus	OK

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Synovial Fluid	Refrigerated (preferred)	90 days	
	Ambient	90 days	
	Frozen	90 days	

Clinical and Interpretive

Clinical Information

Per FDA recommendations, orthopedic surgeons should consider measuring and following serial chromium (Cr) and cobalt (Co) concentrations in EDTA anticoagulated whole blood in symptomatic patients with metal-on-metal hip implants as part of their overall clinical evaluation. However, a recent publication(1) has shown synovial fluid measurements were superior to whole blood and serum Cr and Co concentrations in predicting local tissue destruction in failed hip arthroplasty constructs.

Prosthetic devices produced by Depuy Company, Dow Corning, Howmedica, LCS, PCA, Osteonics, Richards Company, Tricon, and Whiteside are typically made of Cr, Co, and molybdenum. This list of products is incomplete, and the products' compositions change occasionally; see each prostheses' product information for composition details.

Cr:

Cr is a naturally-occurring element widely distributed in the environment. It exists in several valence states with the 3 main forms being Cr(0), Cr(III), and Cr(VI). Cr(III) is an essential trace element that enhances the action of insulin. Deficiency leads to impaired growth, reduced life span, corneal lesions, and alterations in carbohydrates, lipid, and protein metabolism.

Cr is widely used in manufacturing processes to make various metal alloys such as stainless steel. It is also used in many consumer products including: wood treated with copper dichromate, leather tanned with chromic sulfate, and metal-on-metal hip replacements.

The general population is most likely to be exposed to trace levels of Cr, as Cr(III) is naturally occurring in foods, such as fruits, vegetables, nuts, beverages, and meats. The highest potential occupational exposure occurs in the metallurgy and tanning industries, where workers may be exposed to high air concentrations.

Co:

Co is a naturally occurring, hard, grey element widely distributed in the environment. It is used to produce alloys in the manufacturing of aircraft engines, cutting tools, and some artificial hip and knee joint prosthesis devices.

Co is an essential cofactor in vitamin B12, which is necessary for neurological function, brain function, and the formation of blood. For most people, food is the largest source of Co intake. However, more than a million workers are potentially exposed to Co and its compounds, with the greatest exposure in mining processes, cemented tungsten-carbide industry, Co powder industry, and alloy production industry.

Co is not highly toxic, but large doses will produce adverse clinical manifestations. Acute symptoms include pulmonary edema, allergy, nausea, vomiting, hemorrhage, and renal failure. Chronic exposure to Co-containing hard metal (dust or fume) can result in a serious lung disease called "hard metal lung disease," which is a type of pneumoconiosis (lung fibrosis). Furthermore, inhalation of Co particles can cause respiratory sensitization, asthma, shortness of breath, and decreased pulmonary function. Even though the primary route of occupational exposure to Co is the respiratory tract, skin contact is also important because dermal exposures to hard metal and cobalt salts can result in significant systemic uptake. Sustained exposures can cause skin sensitization, which may result in eruptions of contact dermatitis. In cases of suspected toxicity, blood, serum, or urine concentrations of Co can be checked. Vitamin B12 should be used to assess nutritional status.

Reference Values

CHROMIUM:

0-17 years: Not established

> or =18 years: <17.1 ng/mL

COBALT:

0-17 years: Not established

> or =18 years: <17.2 ng/mL

Interpretation

Chromium:

Based on an internal study, synovial fluid chromium concentrations of 17.1 ng/mL or above were more likely due to a metal reaction (eg adverse local tissue reaction [ALTR]/adverse reaction to metal debris [ARMD]) versus a nonmetal reaction in patients undergoing metal-on-metal revision (sensitivity of 84.6% and specificity of 85.2%).

Cobalt:

Based on an internal study, synovial fluid cobalt concentrations of 17.2 ng/mL or above were more likely due to a metal reaction (eg, adverse local tissue reaction [ALTR]/adverse reaction to metal debris [ARMD]) versus a nonmetal reaction in patients undergoing metal-on-metal revision (sensitivity of 80.8% and specificity of 81.5%).

Cautions

Chromium:

Chromium is present in our environment at 100-fold to 1000-fold higher concentration than found in biological tissues. Reports of increased chromium could be due to external contamination. Metal-free blood collection procedures must be followed. Elevated trace element concentrations in the absence of corroborating clinical information do not independently predict prosthesis wear or failure.

Cobalt:

Because this test uses mass spectrometry detection, the radioactive form of cobalt, (60)Co, is not quantified.

Specimen collection procedures for cobalt require special specimen collection tubes, rigorous attention to ultraclean specimen collection and handling procedures, and analysis in an ultraclean facility. Elevated trace element concentrations in the absence of corroborating clinical information do not independently predict prosthesis wear or failure.

Clinical Reference

1. Houdek MT, Wyles CC, Jannetto PJ, et al: Synovial fluid metal levels are superior to whole blood and serum metal ion levels in predicting local tissue destruction in failed hip arthroplasty constructs. Orthopaedic Proceed. 2018;100-B(SUPP_1):39
2. Eltit F, Assiri A, Garbuz D, et al: Adverse reactions to metal on polyethylene implants: Highly destructive lesions related to elevated concentration of cobalt and chromium in synovial fluid. J Biomed Mater Res A. 2017;105(7):1876-1886
3. Lass R, Grubl A, Kolb A, et al: Comparison of synovial fluid, urine, and serum ion levels in metal-on-metal total hip arthroplasty at minimum follow-up of 18 years. J Orthop Res. 2014;32(9):1234-1240
4. De Pasquale D, Stea S, Squarzoni S, et al: Metal-on-metal hip prostheses: Correlation between debris in the synovial fluid and levels of cobalt and chromium ions in the bloodstream. Int Orthop. 2014;38(3):469-475

Performance**Method Description**

Chromium and cobalt are analyzed by inductively coupled plasma-mass spectrometry (ICP-MS).(Unpublished Mayo method)

PDF Report

No

Day(s) Performed

Thursday

Report Available

1 to 7 days

Specimen Retention Time

14 days

Performing Laboratory Location

Rochester

Fees and Codes**Fees**

- Authorized users can sign in to [Test Prices](#) for detailed fee information.
- Clients without access to Test Prices can contact [Customer Service](#) 24 hours a day, seven days a week.

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- Prospective clients should contact their Regional Manager. For assistance, contact [Customer Service](#).

Test Classification

This test was developed and its performance characteristics determined by Mayo Clinic in a manner consistent with CLIA requirements. This test has not been cleared or approved by the U.S. Food and Drug Administration.

CPT Code Information

82495

83018

LOINC® Information

Test ID	Test Order Name	Order LOINC Value
CRCOF	Chromium and Cobalt, Synovial FI	95525-2

Result ID	Test Result Name	Result LOINC Value
606352	Cobalt, Synovial FI	23842-8
606353	Chromium, Synovial FI	95526-0