Test Definition: CRSY

Chromium, Synovial Fluid

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 potential chromium toxicity.

Special Instructions

- Metals Analysis Specimen Collection and Transport

Method Name

Triple-Quadrupole Inductively Coupled Plasma Mass Spectrometry (ICP-MS/MS)

NY State Available

Yes

Specimen

Specimen Type

Synovial Fluid

Ordering Guidance

This test should only be ordered for individuals with chromium or cobalt implants.

Specimen Required

Patient Preparation: High concentrations of gadolinium and iodine are known to potentially interfere with most inductively coupled plasma mass spectrometry-based metal tests. If either gadolinium- or iodine-containing contrast media has been administered, **a specimen should not be collected for 96 hours.**

Supplies:

-Metal Free EDTA 3 mL Tube (T989)

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

Container/Tube:

Preferred: Royal blue-top BD vacutainer with EDTA blood collection tube (3 mL) (BD catalog no. 367777) (T989)

Acceptable: Royal blue-top BD Vacutainer Plus with EDTA blood collection tube (6 mL) (BD catalog no. 368381) (T183)

Specimen Volume: 1 mL

Collection Instructions: See Metals Analysis Specimen Collection and Transport for complete instructions.

Additional Information: Chromium is 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 & Interpretive

Clinical Information

Chromium (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, and corneal lesions, as well as alterations in carbohydrates, lipid, and protein metabolism.

Chromium 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.

Per US Food and Drug Administration recommendations, orthopedic surgeons should consider measuring and following serial chromium 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 chromium 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 chromium, cobalt, and molybdenum. This list of products is incomplete, and the products' compositions change occasionally; see each prostheses' product information for composition details.

The general population is most likely to be exposed to trace levels of chromium, 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. In cases of suspected toxicity, blood, serum, or urine concentrations of chromium can be checked.

Reference Values

0-17 years: Not established

> or =18 years: <16.9 ng/mL

Interpretation

Based on an internal study, synovial fluid chromium concentrations of 16.9 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 92.3% and specificity of 92.6%).

Cautions

This test is intended for monitoring of metallic prosthetic implant wear and should not be ordered to assess potential chromium toxicity.

Chromium is present in the 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 collection procedures must be followed. Elevated trace element concentrations in the absence of corroborating clinical information do not independently predict prosthesis wear or failure.

This test should only be used in individuals with metallic prosthetic implants. The significance of chromium concentrations in synovial fluid in patients without implants is unknown.

Clinical Reference

1. Houdek MT, Taunton MJ, Wyles CC, Jannetto PJ, Lewallen DG, Berry DJ. Synovial fluid metal ion levels are superior to blood metal ion levels in predicting an adverse local tissue reaction in failed total hip arthroplasty. J Arthroplasty. 2021;36(9):3312-3317.e1. doi:10.1016/j.arth.2021.04.034
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. doi:10.1002/jbm.a.36057
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 a minimum follow-up of 18 years. J Orthop Res. 2014;32(9):1234-1240. doi:10.1002/jor.22652
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. doi:10.1007/s00264-013-2137-5
5. Wise JP Jr, Young JL, Cai J, Cai L. Current understanding of hexavalent chromium [Cr(VI)] neurotoxicity and new perspectives. Environ Int. 2022;158:106877. doi:10.1016/j.envint.2021.106877

Performance

Method Description

The metal of interest is analyzed by triple-quadrapole inductively coupled plasma mass spectrometry.(Unpublished Mayo method)

PDF Report

No

Day(s) Performed

Friday

Report Available
2 to 15 days

Specimen Retention Time
14 days

Performing Laboratory Location
Mayo Clinic Laboratories - Rochester Superior Drive

Fees & 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.
- Prospective clients should contact their account representative. 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. It has not been cleared or approved by the US Food and Drug Administration.

CPT Code Information
82495

LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
CRSY	Chromium, Synovial Fl	95526-0

Result ID	Test Result Name	Result LOINC® Value
606353	Chromium, Synovial Fl	95526-0