

Mixing Metals During Operative Fixation and Reconstruction in the Appendicular Skeleton: Is There a Detrimental Clinical Impact That Translates From Theoretical In Vivo Galvanization?

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Purpose: Orthopaedic surgeons have traditionally been advised against mixing varying metal types to avoid the potential for in vivo galvanization and corrosion found in early animal models. However, clinical practice often includes the use of mixed metals (MM) with seemingly minimal adverse outcomes. The purpose of this study was to retrospectively analyze patients who have undergone operative reconstruction with MM to report any related complications.

Methods: Between 2017-2022, our institutional fracture and reconstruction registry was screened for inclusion. Inclusion criteria included any patient with "mixed" fixation defined as contact and proximity within the bone (≤ 10 mm) determined by patients with complete radiographs and records with 1-year minimum follow-up.

Patient baseline characteristics, perioperative data, and postoperative data including radiographs and complications were collected. We identified 549 potential patients, of which 241 were determined to have been treated with MM implants.

Results: The final analysis included 110 patients, with a mean age of 63 ± 15.1 years, mean body mass index of 29.0 ± 8.0 kg/m², and mean Charlson Comorbidity Index (CCI) of 2.6 ± 1.9 . 51% of the MM implants had direct metal-on-metal contact, and the average distance between non-contacting metals was 0.58 ± 0.3 cm. The most common combination of metals was titanium + stainless steel (43%) and titanium + cobalt chromium (44%). The most common combination of MM implants was cerclage wire on arthroplasty implant (40%), followed by plate on arthroplasty implant (21%), and plate on nail (16%). The most common area of MM implants was within the femur (64%). At mean postoperative follow-up of 24.7 ± 14.7 months, hardware-related complications were observed in 29 patients (26%), with reoperation due to hardware-complications in 26 (24%) within 19.0 ± 15.5 months. No evidence of metal-on-metal galvanic corrosion was observed on radiographic evaluation. Binary logistic regression analysis did not reveal any significant associations between hardware related complications and age, sex, smoking status, American Society of Anesthesiologists scores, direct MM implant contact, proximity of MM implants ≤ 10 mm, or type of MM.

Conclusion: Patients who received MM implants showed no radiographic signs of corrosion and had a similar rate of hardware-related complications as general orthopaedic procedures reported in historic literature. While theoretical concerns exist regarding use of MM implants, these findings suggest that the consequence of such combinations in clinical practice may not be as significant as previously suggested.