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| <b>Publication</b> | <p><b>Dual-energy CT and ceramic or titanium prostheses material reduce CT artifacts and provide superior image quality of total knee arthroplasty.</b><br/>Kasperek MF, Töpker M, Lazar M, Weber M, Kasperek M, Mang T, Apfaltrer P, Kubista B, Windhager R, Ringl H.<br/>Knee Surg Sports Traumatol Arthrosc. 2019 May;27(5):1552-1561.<br/>doi: 10.1007/s00167-018-5001-8. Epub 2018 Jun 7.</p> <p><a href="https://pubmed.ncbi.nlm.nih.gov/29881885/">https://pubmed.ncbi.nlm.nih.gov/29881885/</a> (free PMC article)</p>                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Study</b>       | <p>This study evaluated the influence of different CT examination techniques (dual-energy CT, single-energy CT) and prosthesis material on image quality and the extent of metal artefacts.</p> <p>The aim of this study was to gain a better understanding regarding these artefacts, to determine the most appropriate CT protocol and to obtain a comprehensive overview of the CT image quality of the different implant materials used in TKA.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Implant</b>     | <p><b>BPK-S Integration: CoCr alloy (PETER BREHM GmbH)</b><br/><b>BPK-S Integration Ceramic: all-ceramic prosthesis</b></p> <p>LCS®: CoCr alloy (DePuy Synthes Inc.)<br/>LCS® TiNi: Titanium alloy with ceramic coating</p> <p>ACS®: CoCr alloy (Implantcast GmbH)<br/>ACS® Titannitrid (TiN): CoCr alloy with ceramic coating</p> <p>Vanguard™: CoCr alloy (Biomet Inc.)<br/>Vanguard™ Titan-Niob-Nitrid (TiNbN): CoCr alloy with ceramic coating</p> <p>Columbus®: CoCr alloy (Aesculap AG)<br/>AS Columbus®: CoCr alloy with ceramic coating (ZrN)</p> <p>Legion™: CoCr alloy (Smith &amp; Nephew PLC)<br/>Legion™ Oxinium®: Zirconium-niobium metal alloy with ceramic zirconium oxide surface</p> <p>NextGen® LPS: CoCr alloy (Zimmer Inc.)<br/>NextGen® Tivanium® LPS: all-titanium alloy prosthesis (Ti6Al4V)</p> <p>Scorpio®: CoCr alloy (Stryker Corp.)<br/>Scorpio® TiNi: CoCr alloy with ceramic coating</p> |
| <b>Patients</b>    | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Follow-up</b>   | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

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| <p><b>Methods</b></p>    | <p>The femoral components of 8 pairs of total knee prosthesis from different manufacturers were examined in a phantom set-up. Each pair consisted of a conventional CoCr prosthesis and the corresponding hypoallergenic prosthesis from the same manufacturer.</p> <p>The hypoallergenic versions consisted of either all-ceramic, titanium alloy (with or without ceramic coating), CoCr alloys with a ceramic-coated surface ((TiN, TiNbN, ZrN) or the Oxinium® prosthesis made of zirconium-niobium metal alloy with ceramic zirconia surface (shiny black "ceramicised metal").</p> <p>Due to the differences in size and construction of the prostheses, only the extent of artefacts within a particular pair of manufacturers was compared to determine the influence of different material compositions on the images. Within all pairs, the diameters of the condyles and the shapes were always identical.</p> <p>All scans were performed with a 2nd generation dual-energy, multidetector CT scanner (Siemens Somatom Definition Flash CT, Siemens Healthineers). A total of 9 different protocols were applied to 16 different phantoms, resulting in 144 scans. Seven scans were performed with the dual-energy CT technique and 2 scans with a single-energy CT. Quantitative and qualitative image analyses were performed.</p> |
| <p><b>Results</b></p>    | <p>The <b>image quality of the bone-prosthesis interface</b> of the <b>all-ceramic knee prosthesis BPK-S Integration Ceramic</b> and the <b>titanium prostheses</b> (LCS® TiNi, NextGen® Tivanium® LPS) was evaluated as <b>superior</b> compared to the conventional CoCr versions. They shows <b>significantly fewer artefacts</b> compared to the standard CoCr version (<math>p &lt; 0.001</math>).</p> <p>All <b>CoCr prostheses with ceramic coating</b> (ACS®, Vanguard™, Columbus®, Scorpio®) and the <b>Oxinium® prosthesis</b> were rated <b>similar or worse than the standard CoCr version</b>.</p> <p>The CoCr prostheses ACS® and Scorpio® with ceramic coating shows slightly fewer artifacts than the corresponding standard CoCr prosthesis.</p> <p>The <b>Oxinium® version</b> shows a <b>significantly higher number of artefacts than the standard CoCr prosthesis</b> (<math>p=0.001</math>).</p> <p>A comparable number of artifacts was found in the Vanguard™ and Columbus® prosthesis pairs.</p>                                                                                                                                                                                                                                                                                                                        |
| <p><b>Key Points</b></p> | <p>The <b>artefact-free CT visualisation</b> of total knee arthroplasties plays an important role in the <b>assessment of periprosthetic loosening</b>. Excellent image quality and low artefact incidence are crucial.</p> <p>According to the authors, less attenuating materials such as <b>ceramics or titanium</b> may be particularly <b>beneficial</b> for <b>posterior stabilised TKA</b>. This is because the metal box blocks visualisation of the distal aspect of the condyles and is associated with a higher number of artifacts, as seen in the only posterior stabilised knee design (NextGen®) in the study.</p> <p>The authors emphasise that the results support the use of <b>ceramics and titanium</b> as the <b>main composite materials in TKA</b> to achieve <b>better image quality of the bone-prosthesis interface</b>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

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| <b>Key Points</b>    | <p>The <b>all-ceramic knee prosthesis BPK-S Integration Ceramic</b> and the <b>titanium knee prostheses</b> show <b>significantly fewer artefacts</b> on CT compared to the CoCr standard versions and enabled an <b>excellent diagnostic assessment of the bone-prosthesis interface</b>.</p> <p>The <b>CoCr prostheses with ceramic coating</b> show <b>only slightly fewer artefacts</b> than the corresponding CoCr versions. The "subjective" image quality was almost identical.</p> <p>The <b>Oxinium® prosthesis</b> shows <b>significantly more artefacts</b> than the corresponding CoCr standard prosthesis.</p> <p>According to the authors, in terms of daily clinical practice, the results suggest the use of <b>dual-energy CT imaging</b> to improve the <b>assessment of the bone-prosthesis interface in painful TKA</b>. The <b>material</b> could be an <b>important factor</b> in the choice of knee endoprosthesis in the future.</p> |
| <b>Abbreviations</b> | <p>TKA – total knee arthroplasty, CoCr – cobalt chromium, TiN – titanium nitride, TiNbN – titanium niobium nitride, ZrN – zirconium nitride</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

