

BioXmark® publications & abstracts

Bladder Cancer

de Ridder M, Gerbrandy LC, de Reijke TM, Hinnen KA, Hulshof MCCM. **BioXmark® liquid fiducial markers for image-guided radiotherapy in muscle invasive bladder cancer: a safety and performance trial.** BJR. 2020 Jun 1;20200241. <https://www.birpublications.org/doi/abs/10.1259/bjr.20200241>

de Ridder M, Gerbrandy LC, De Reijke TM, Hinnen KA, Hulshof MCCM. **A novel liquid fiducial marker for image-guided adaptive radiotherapy in bladder cancer** [poster at ESTRO 2020]. <https://www.estro.org/library/item/7004/a-novel-liquid-fiducial-marker-for-image-guided-adaptive-radiotherapy-in-bladder-cancer>

Hafeez S, Hansen VN, McNair H, Harris E, Jones K, Schmidt M, Kumar P, Huddart R. **Assessing feasibility of a new fundicial marker (BioXmark) for bladder tumor localization and position verification during radical radiotherapy in a porcine phantom.** Abstract 30th EUS Annual Meeting, New Orleans, LA, 2015 May 16. http://engineering-urology.org/am/30EUS_2015.pdf (Abstract 8; P: 22)

Esophageal Cancer

Machiels M, Voncken FEM, Jin P, Dieren JM van, Bartels-Rutten A, Alderliesten T, Aleman BMP, Hooft JE van, Hulshof MCCM. **A Novel Liquid Fiducial Marker in Esophageal Cancer Image Guided Radiation Therapy: Technical Feasibility and Visibility on Imaging.** Practical Radiation Oncology. 2019 Nov 1;9(6): e506–15. <https://pubmed.ncbi.nlm.nih.gov/31279938/>

de Blanck SR, Scherman-Rydhög J, Siemsen M, Christensen M, Baeksgaard L, Irming Jølck R, Specht L, Andresen TL, Persson GF. **Feasibility of a novel liquid fiducial marker for use in image guided radiotherapy of esophageal cancer.** Br J Radiol. 2018 Dec;91(1092):20180236. <https://pubmed.ncbi.nlm.nih.gov/29975152/>

Jelvehgaran P, Alderliesten T, Weda JJA, de Bruin M, Faber DJ, Hulshof MCCM, van Leeuwen TG, van Herk M, de Boer JF. **Visibility of fiducial markers used for image-guided radiation therapy on optical coherence tomography for registration with CT: An esophageal phantom study.** Med Phys. 2017 Dec;44(12):6570–82. <https://www.ncbi.nlm.nih.gov/pubmed/29023771>

Head & Neck cancer

Steybe D, Russe MF, Ludwig U, Sprave T, Vach K, Semper-Hogg W, Schmelzeisen R, Voss PJ, Poxleitner P. **Intraoperative marking of the tumour resection surface for improved radiation therapy planning in head and neck cancer: preclinical evaluation of a novel liquid fiducial marker.** Dentomaxillofac Radiol. 2021 Mar 1;50(3):20200290. <https://pubmed.ncbi.nlm.nih.gov/32915672/>

Steybe D, Poxleitner P, Voss PJ, Metzger MC, Schmelzeisen R, Bamberg F, Kim S, Russe MF. **Evaluation of computed tomography settings in the context of visualization and discrimination of low dose injections of a novel liquid soft tissue fiducial marker in head and neck imaging.** BMC Med Imaging. 2021 Oct 27;21(1):157. <https://pubmed.ncbi.nlm.nih.gov/34702192/>

Clerc-Renaud B, Boss M-K, Griffin LR, LaRue SM, Leary D. **Potential for BioXmark liquid fiducial marker to improve identification of superficial component of canine oral tumors for computer-based radiation therapy planning.** Can Vet J. 2019 Oct;60(10):1072–80. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6741831/>

Breast Cancer

Ciernik IF, Greiss AM. **Visualization of the tumor cavity after lumpectomy of breast cancer for postoperative radiotherapy.** Clinical and Translational Radiation Oncology. 2019 Jan; 14:47–50.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6279963/>

Lung Cancer

de Blanck SR, Rydhög JS, Larsen KR, Clementsen PF, Josipovic M, Aznar MC, af Rosenschöld PM, Jølcck RI, Specht L, Andresen TL, Persson GF. **Long term safety and visibility of a novel liquid fiducial marker for use in image guided radiotherapy of non-small cell lung cancer.** Clinical and Translational Radiation Oncology. 2018 Nov; 13:24–8. <https://pubmed.ncbi.nlm.nih.gov/30258990/>

Scherman Rydhög J, Riisgaard de Blanck S, Josipovic M, Irming Jølcck R, Larsen KR, Clementsen P, Lars Andersen T, Poulsen PR, Fredberg Persson G, Munck af Rosenschöld P. **Target position uncertainty during visually guided deep-inspiration breath-hold radiotherapy in locally advanced lung cancer.** Radiotherapy and Oncology. 2017 Apr;123(1):78–84. <https://www.ncbi.nlm.nih.gov/pubmed/28245908>

Rydhög JS, Mortensen SR, Larsen KR, Clementsen P, Jølcck RI, Josipovic M, Aznar MC, Specht L, Andresen TL, Rosenschöld PM af, Persson GF. **Liquid fiducial marker performance during radiotherapy of locally advanced non small cell lung cancer.** Radiotherapy and Oncology. 2016 Oct;121(1):64–9. <https://pubmed.ncbi.nlm.nih.gov/27443450/>

Rydhög Scherman J, Perrin R, Jølcck RI, Gagnon-Moisan F, Larsen KR, Clementsen P, Riisgaard de Blanck S, Fredberg Persson G, Weber DC, Lomax T, Andresen TL, Munck af Rosenschöld P. **Liquid fiducial marker applicability in proton therapy of locally advanced lung cancer.** Radiotherapy and Oncology. 2017 Mar;122(3):393–9. <https://pubmed.ncbi.nlm.nih.gov/28104299/>

Scherman JR, Irming Jølcck R, Andresen TL, Munck af Rosenschöld P. **Quantification and comparison of visibility and image artifacts of a new liquid fiducial marker in a lung phantom for image-guided radiation therapy: A new liquid fiducial marker for IGRT.** Med Phys. 2015 May 15;42(6Part1):2818–26. <https://www.ncbi.nlm.nih.gov/pubmed/26127034>

Stomach and other upper GI cancers

Bleeker M, Pouw R, Bel A, Sonke JJ, Hulshof M, Horst A van der. **Feasibility of endoscopic fiducial marker implantation in the stomach for use in image-guided RT.** In 2022 [cited 2022 Apr 28]. Available from: <https://www.estro.org/Congresses/ESTRO-2022/652/uppergi/10919/feasibilityofendoscopicfiducialmarkerimplantationi>

Stefanowicz S, Möller ML, Thiele J, Jaster M, Hoinkis C, Troost EGC. **Novel fiducial marker has optimal characteristics for image-guided radiotherapy of abdominal tumours.** In ES: DRAFT EDITORS S.L.; 2020 [cited 2022 Sep 28]. Available poster from: https://www.postersessiononline.eu/173580348_eu/congresos/ESTRO2020/aula/-PO_1669_ESTRO2020.pdf

Pancreatic Cancer

Schneider S, Aust DE, Brückner S, Welsch T, Hampe J, Troost EGC, Hoffmann AL. **Detectability and structural stability of a liquid fiducial marker in fresh ex vivo pancreas tumour resection specimens on CT and 3T MRI.** Strahlenther Onkol. 2019 Aug;195(8):756–63. <https://pubmed.ncbi.nlm.nih.gov/31143995/>

Schneider S, Jølk R, Troost EGC, Hoffmann AL. **Quantification of MRI visibility and artifacts at 3T of liquid fiducial marker in a pancreas tissue-mimicking phantom.** Med Phys. 2018 Jan;45(1):37–47. <https://www.ncbi.nlm.nih.gov/pubmed/29136287>

Dobiasch S, Kampfer S, Burkhardt R, Schilling D, Schmid TE, Wilkens JJ, Combs SE. **BioXmark for high-precision radiotherapy in an orthotopic pancreatic tumor mouse model: Experiences with a liquid fiducial marker.** Strahlenther Onkol. 2017 Dec;193(12):1039–47. <https://www.ncbi.nlm.nih.gov/pubmed/28808749>

Prostate Cancer

De Roover R, Crijns W, Poels K, Peeters R, Draulans C, Haustermans K, Depuydt T. **Characterization of a novel liquid fiducial marker for multimodal image guidance in stereotactic body radiotherapy of prostate cancer.** Med Phys. 2018 May;45(5):2205–17. <https://www.ncbi.nlm.nih.gov/pubmed/29537613>

Rectal Cancer

Opbroek TJS, Willems YCP, Verhaegen F, de Ridder R, Hoge C, Melenhorst J, Bakers F, Grabsch HI, Buijsen J, Van Limbergen EJ, Canters RAM, Berbée M. **BioXmark® liquid fiducials to enable radiotherapy tumor boosting in rectal cancer, a feasibility trial.** Clinical and Translational Radiation Oncology. 2022 Nov;38:90–5. <https://pubmed.ncbi.nlm.nih.gov/36407490/>

Berbée M, Opbroek T, Paulissen J, Houben R, Van Limbergen E, Ta B, Steenbakkens I, Verhaegen F, de Ridder R, Jansen R, Melenhorst J, Bakers F, Grabsch H, Buijsen J, Canters R. **BioXmark liquid fiducials to enable radiotherapy tumor boosting in rectal cancer feasibility trial.** [Poster at ESTRO 2020] <https://www.estro.org/Congresses/ESTRO-2020/192/physicstrack-implementationofnewtechnology-techniq/412/bioxmarkliquidfiducialstoenabletheradiotherapytumorbo>

Development of Technology

Wang W, Hansen AE, Sun H, Fliedner FP, Kjaer A, Jensen AI, Andresen TL, Henriksen JR. **Carbohydrate based biomarkers enable hybrid near infrared fluorescence and ⁶⁴Cu based radio-guidance for improved surgical precision.** Nanotheranostics. 2021;5(4):448–60. <https://pubmed.ncbi.nlm.nih.gov/34055574/>

Hansen AE, Henriksen JR, Jølk R, Fliedner FP, Bruun LM, Scherman J, Jensen AI, Munck Af Rosenschöld P, Moorman L, Kurbegovic S, de Blanck SR, Larsen KR, Clementsen PF, Christensen AN, Clausen MH, Wang W, Kempen P, Christensen M, Viby NE, Persson G, Larsen R, Conradsen K, McEvoy FJ, Kjaer A, Eriksen T, Andresen TL. **Multimodal soft tissue markers for bridging high-resolution diagnostic imaging with therapeutic intervention.** Sci Adv. 2020 Aug 19;6(34) <https://pubmed.ncbi.nlm.nih.gov/32875113/>

Bertholet J, Knopf A, Eiben B, McClelland J, Grimwood A, Harris E, Menten M, Poulsen P, Nguyen DT, Keall P, Oelfke U. **Real-time intrafraction motion monitoring in external beam radiotherapy.** Phys Med Biol. 2019 Aug;64(15):15TR01. <https://pubmed.ncbi.nlm.nih.gov/31226704/>

Troost E, Menkel S, Enghardt W, Hytry J, Kunath D, Makocki S, Hoffmann A, Jølk R. EP-1710: **Chemical stability of BioXmark® following normofractionated and single-fraction proton beam therapy.** Radiotherapy and Oncology. 2017 May 1;123:S937–8 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6871657/>

Rydhög JS, Jølk R, Andresen TL, Rosenschöld PM af. PO-0964: **Artefact quantification of liquid and solid fiducial marker in single and dual energy CT with MAR.** Radiotherapy and Oncology. 2015 Apr 1;115: S510. <http://nanovi.com/wp-content/uploads/2021/08/Rydhog-J-et-al.-poster.pdf>

Evaluation of Safety and Feasibility of BioXmark®

Brown KH, Ghita M, Schettino G, Prise KM, Butterworth KT. **Evaluation of a Novel Liquid Fiducial Marker, BioXmark®, for Small Animal Image-Guided Radiotherapy Applications.** *Cancers (Basel)*. 2020 May 18;12(5):1276. doi: 10.3390/cancers12051276. <https://pubmed.ncbi.nlm.nih.gov/32443537/>

Mortensen SR, Scherman JB, Larsen KR, Jølcck RI, Persson GF, Hansen AE, Eriksen T, Specht L. **Use of a Novel Liquid Fiducial Marker Injected with Endoscopic Ultrasound Equipment for Use in Image Guided Radiation Therapy of Thoracic Tumors (Porcine Model).** *International Journal of Radiation Oncology Biology Physics*. 2014 Sep 1;90(1): S651. [http://www.redjournal.org/article/S0360-3016\(14\)02577-2/abstract](http://www.redjournal.org/article/S0360-3016(14)02577-2/abstract)

Hamming VC, Brouwer CL, Van Goethem MJ, Jolck RI, Van Leijsen C, Van den Bergh ACM. **PO-0866: Visibility, image artifacts and proton dose perturbation of fiducial markers.** *Radiotherapy and Oncology*. 2017 May;123:S471–2. [https://www.thegreenjournal.com/article/S0167-8140\(17\)31303-8/pdf](https://www.thegreenjournal.com/article/S0167-8140(17)31303-8/pdf)