

A Novel 3D Printed Fully-guided Palatal Expansion Device in Support of Full Mouth Rehabilitation

Matthew J. Turner DDS, LCDR/ DC/ USN; Barry E. Peterson, DDS, MS, CAPT/DC/USN; Timothy P. Daudelin, DDS, MS, FACP, LCDR/DC/USN; Stacy L. Yu, DDS, FACP, CDR/DC/USN

Naval Postgraduate Dental School, Uniformed Services University of the Health Sciences, Walter Reed National Military Medical Center, Bethesda, MD

Introduction

Correction of maxillary transverse deficiency in adults traditionally involves invasive surgical procedures such as surgically assisted rapid palatal expansion (SARPE) or segmental Le Fort I osteotomy.¹ However, the integration of computer-aided design and manufacturing (CAD/CAM) technologies has enabled the use of targeted mini-implant-assisted rapid palatal expansion (MARPE) appliances as a less invasive alternative with predictable outcomes.² Minimizing surgical complications and reducing post-operative healing time are critical considerations during treatment planning.



Figure 1: Patient presentation with maxillary transverse deficiency, forward functional shift, and collapsed occlusal vertical dimension (OVD) in need of a fixed full mouth rehabilitation.

Purpose

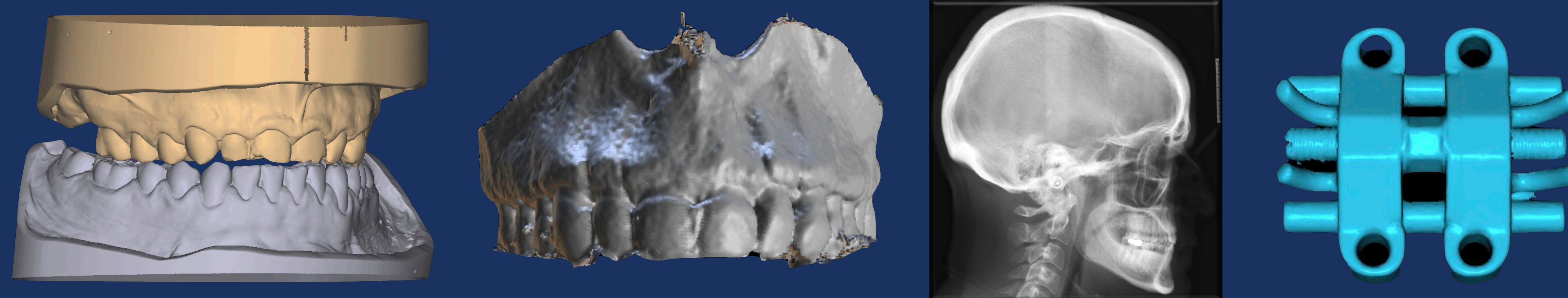
To outline the planning, design, and implementation of a novel palatal expansion device aimed at correcting a bilateral reverse articulation with a forward functional shift and generalized tooth structure loss in a 44-year-old Turner Class I adult male as part of preparatory treatment prior to restorative rehabilitation with fixed restorations.

Disclaimer

The views expressed in this article reflect the results of a case conducted by the author and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense, the Uniformed Services University of the Health Sciences, nor the United States Government. I am a military service member of the United States government. This work was prepared as part of my official duties. Title 17 U.S.C. 105 provides that copyright protection under this title is not available for any work of the United States Government. Title 17 U.S.C. 101 defines a U.S. Government work as work prepared by a military service member or employee of the U.S. Government as part of that person's official duties. CONFLICT OF INTEREST: No conflict of interest to disclose.

Design and Implementation Protocol

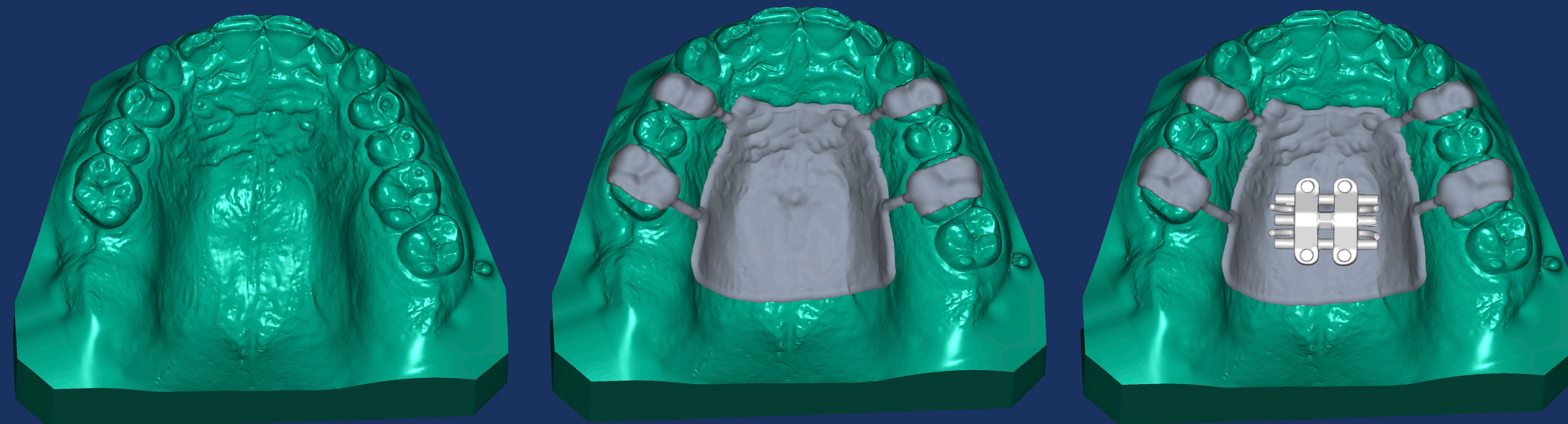
1. Acquired intraoral scans of existing dentition in centric relation, maxillary arch CBCT, a lateral cephalometric image, and a scan of the selected Maxillary Skeletal Expander (MSE, 10 mm; Great Lakes Dental Technologies).



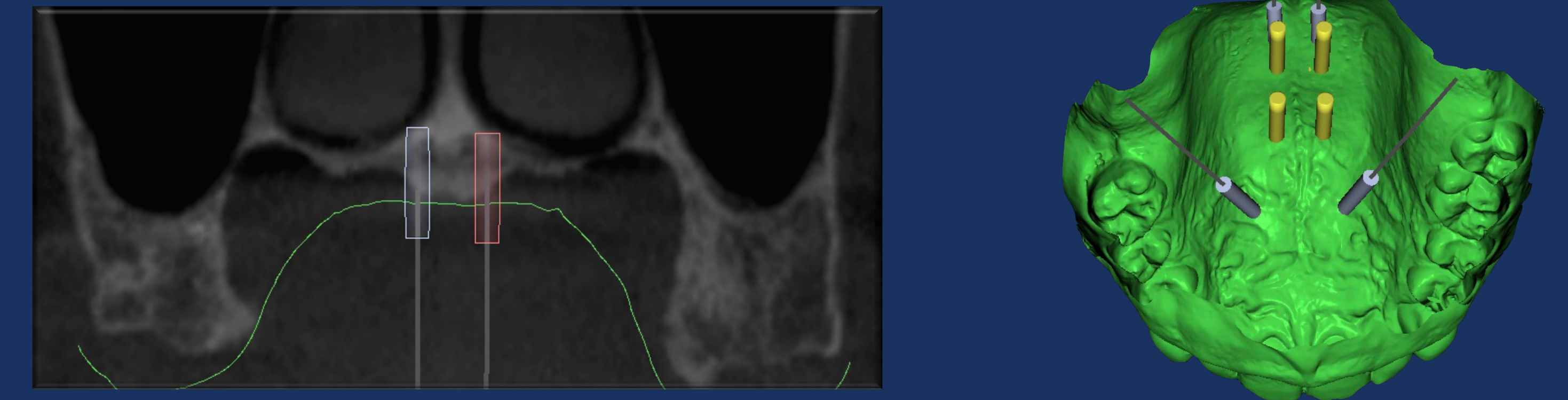
2. Intraoral mock-up completed to verify esthetics and proposed change in OVD. Proposed OVD was tested with a removable occlusal device for 4 weeks.



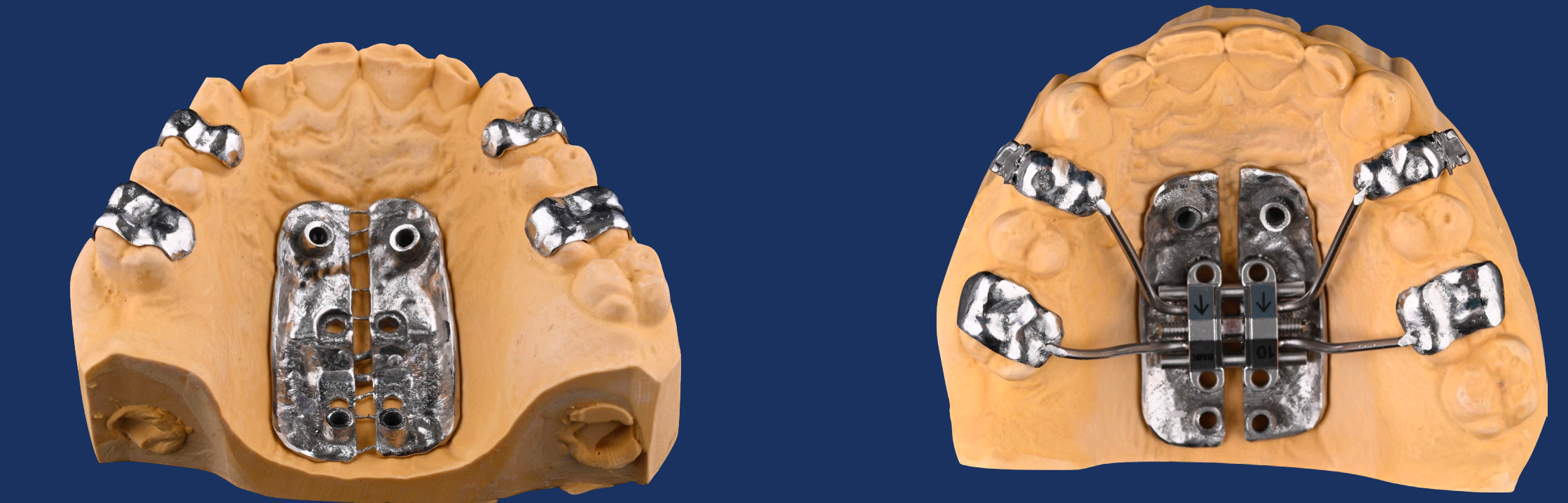
3. ExoCad (Align Technologies) software program was used to design a palatal support piece. Occlusal alignment rests were added at the proposed OVD. The proposed position of the MSE was added to the palatal support piece.



4. This model was brought into an implant planning software program (Blue Sky Bio) and merged to the patient's CBCT. Eight Temporary Anchorage Device (TAD) implants were planned for both location and depth to engage the hard palate bi-cortically.



5. Merged stereolithography (STL) files of the palatal support piece, implants, and MSE were brought into 3D modeling software (Meshmixer, Autodesk Inc.) and guide sleeves were added to the appliance to control TAD placement and depth. The palatal support piece and occlusal alignment rests were printed in cobalt chromium (XM200G by Xact Metal Inc.). MSE and 22 slot MBT brackets were laser welded (Orion LZR100) to the printed components.



6. At time of placement, the occlusal rests were cemented with Multilink Automix (Ivoclar). TADs were placed to depth using an Orthonia Torque Driver and Contra-Angle Driver for TAD (RMO).



Results and Conclusion

Successful placement of appliance with eight bi-cortical TADs. 1 mm of expansion was noted after week one, with no further expansion upon follow-up appointments despite activation attempts. Outward bowing of the transverse sliding bars was observed. The appliance was removed at the three-week mark with minimal tissue overgrowth or erythema.

This novel MARPE approach may eliminate surgical intervention, reduce complications, and simplify appliance placement. Future designs may require a second MSE to increase expansion force³ or the possibility of using a less rigid implant borne expander.

References

1. Brunetto DP, Sant'Anna EF, Machado AW, Moon W. Non-surgical treatment of transverse deficiency in adults using Microimplant-assisted Rapid Palatal Expansion (MARPE). Dental Press J Orthod. 2017 Feb;22(1):110-125. doi: 10.1590/2177-6709.22.1.110-125.sar. PMID: 28444019; PMCID: PMC5398849.
2. Ceschi M, Riatti R, Di Leonardo B, Contardo L. Skeletal expansion using a miniscrew-assisted rapid palatal expansion in a 50-year-old patient. Am J Orthod Dentofacial Orthop. 2022 Oct;162(4):568-579. doi: 10.1016/j.ajodo.2021.03.030. Epub 2022 Jul 7. PMID: 35811187.
3. Maino BG, Paoletto E, Cremonini F, Liou E, Lombardo L. Tandem Skeletal Expander and MAPA Protocol for Palatal Expansion in Adults. J Clin Orthod. 2020 Nov;54(11):690-704. PMID: 33476295.