RESEARCH LETTER

Development of a Tongue-Piercing Method for Use With Assistive Technology

Piercing the tongue for wearing jewelry is not infrequent among young adults. The procedure is not usually performed by medical personnel. A new assistive technology for people with tetraplegia, the Tongue Drive System (TDS), utilizes voluntary tongue movements for control. The operator uses a magnet attached to the tongue together with an externally mounted sensor array that detects changes in the magnetic field to drive powered wheelchairs and access computers. We hypothesized that a magnet-containing barbell would provide a semipermanent means of attaching the magnet to the tongue. Our aims were to design a medically appropriate tongue-piercing method and to confirm that using a magnet-containing tongue barbell works to control the TDS.

Methods | After reviewing the scientific and trade literature, discussing with dentists, oral surgeons, and otolaryngologists, and observing community piercers, we developed a tongue-piercing protocol and refined it during implementation. Each participant underwent tongue piercing and placement of a magnet-containing barbell (Box 1). Five half-day testing sessions using the TDS to drive a powered wheelchair and perform computer tasks were performed. The study was approved by the Northwestern University institutional review board. All participants gave written consent before any study activities were started.

Results | Ten healthy adults were screened for normal tongue mobility and adequate intraoral space. Three were ineligible because of a short lingual frenulum (ankyloglossia). The tongues of 7 individuals (6 women, 1 man) were pierced and a stainless steel 316 LVM internally threaded tongue barbell inserted in each. One participant removed the barbell and exited the study 48 hours after piercing as a result of swelling and discomfort.

Mean (range) pain scores, rated on a 0 to 10 scale, were 5.8 (1-8) on day 1, 4.0 (1-7) on day 2, and 2.9 (1-5) on day 3. Boley gauge (a type of caliper) measurements and plethysmography revealed increased tongue dimensions and decreased intraoral volume, respectively, on day 1, but these measurements returned to baseline by week 4. Drooling and difficulty swallowing, eating, and speaking were noted by most participants on day 1. The incidence and severity decreased by day 3. Calculus developed on the ventral ball of the barbell in all participants by week 4.

During a 6-week period, all 6 remaining participants completed at least 2 TDS testing sessions, and 4 of the 6 completed 5 TDS testing sessions. All 6 participants were able to operate the TDS effectively.

Discussion | Thirty percent of candidates were ineligible to participate because of motion-limiting ankyloglossia. In the future, frenotomies in people with tetraplegia to allow operation of authenticated tongue-based assistive technologies may be justifiable. Only internally threaded barbells were used in order to avoid tearing tongue muscle on insertion. Nickel hypersensitivity was avoided by using initial barbells expected to release less than 0.2 μg/cm²/wk of nickel. During the second phase, the rare earth metal magnet was completely encased in a titanium barbell.

Boley gauge measurements helped determine the lengths of barbell shafts on the basis of tongue thickness allowing for 6.35-mm swelling. Plethysmography data confirmed tongue swelling but less than expected. We attribute this to strict adherence to detailed aftercare instructions.

The use of chlorhexidine gluconate mouthwash for the first week and ongoing use of an antiplaque mouthwash may have helped prevent early infections. However, the appearance of lower ball calculus after only 4 weeks of wear underlines the importance of assiduous cleaning of barbells. Proximal placement of barbells was done to prevent gum and tooth damage. The TDS was operated effectively from this position.
In conclusion, a medically appropriate tongue-piercing protocol was developed. It was used to place a magnet-containing barbell that effectively operated the TDS.

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Additional Information: The US Food and Drug Administration determined that the study was a non–significant risk device study.

Additional Contributions: BodyOrnament Company/Blue Mountain Steel, Inc, donated barbells and piercing supplies; Anatometal, Inc, designed and manufactured the magnet-containing tongue barbells; and Pride Mobility, Inc, donated the powered wheelchair.


Study limitations include the small number of participants, the exclusion of those with chronic conditions that might have delayed wound healing, and the variability of tongue thickness measurements because dimensions changed depending on the position and degree of tongue protrusion.