C2 translaminar screw fixation

C2 translaminar screw placement refers to a surgical procedure in which screws are placed through the C2 vertebra (axis) and into the laminae on either side. This procedure is commonly used to stabilize the C1-C2 segment of the cervical spine, which is responsible for about 50% of cervical spine rotation.

Translaminar screws offer several advantages over other types of screws, such as pedicle screws or lateral mass screws, including a lower risk of vertebral artery injury and a reduced need for fusion. Additionally, the translaminar technique allows for greater screw length and angulation, which can provide greater stability and allow for more complex corrections.

However, there are also risks associated with C2 translaminar screw placement, such as the potential for neural damage, bleeding, and infection. As with any surgical procedure, it is important to carefully weigh the potential risks and benefits before deciding to undergo the procedure. Additionally, the procedure should only be performed by an experienced and qualified spinal surgeon.

Du et al. conducted a study to investigate the biomechanical feasibility and stability of C1 lateral mass-C2 bicortical translaminar screw (C1LM-C2TL) fixation, C1 lateral mass-C2/3 transarticular screw (C1LM-C2/3TA) fixation, and C1LM-C2/3TA fixation with transverse cross-links (C1LM-C2/3TACL) as alternative techniques to the Goel-Harms technique (C1 lateral mass-C2 pedicle screw [C1LM-C2PS] fixation) for atlantoaxial fixation.

Eight human cadaveric cervical spines (occiput-C7) were tested using an industrial robot. Pure moments that were a maximum of 1.5 Nm were applied in flexion-extension (FE), lateral bending (LB), and axial rotation (AR). The specimens were first tested in the intact state and followed by destabilization (a type II odontoid fracture) and fixation as follows: C1LM-C2PS, C1LM-C2TL, C1LM-C2/3TA, and C1LM-C2/3TACL. For each condition, the authors evaluated the range of motion and neutral zone across C1 and C2 in all directions.

Compared with the intact spine, each instrumented spine significantly increased in stability at the C1-2 segment. C1LM-C2TL fixation demonstrated similar stability in FE and LB and greater stability in AR than C1LM-C2PS fixation. C1LM-C2/3TA fixation was equivalent in LB and superior in FE to those of C1LM-C2PS and C1LM-C2TL fixation. During AR, the C1LM-C2/3TA-instrumented spine failed to maintain segmental stability. After adding a cross-link, the rotational stability was significantly increased in the C1LM-C2/3TACL-instrumented spine compared with the C1LM-C2/3TA-instrumented spine. Although inferior to C1LM-C2TL fixation, the C1LM-C2/3TACL-instrumented spine showed equivalent rotational stability to the C1LM-C2PS-instrumented spine.

On the basis of our biomechanical study, C1LM-C2TL and C1LM-C2/3TACL fixation resulted in satisfactory atlantoaxial stabilization compared with C1LM-C2PS. Therefore, the authors believe that the C1LM-C2TL and C1LM-C2/3TACL fixation may serve as alternative procedures when the Goel-Harms technique (C1LM-C2PS) is not feasible due to anatomical constraints [1)].

Twenty-three patients who underwent C1 lateral mass screw (LMS)-C2 translaminar screw (TLS) and 29 who underwent C1 LMS-C2 pedicle screw (PS) fixation with ≥ 2 years of follow-up were

retrospectively analyzed. Three-planar (sagittal, coronal, and axial) radiographic parameters were measured. Patient-reported outcomes (PROs) including the Neck Disability Index (NDI), Japanese Orthopaedic Association (JOA) score and the Short Form 36 Physical Component Summary (SF-36 PCS) were documented. Factors potentially associated with PROs were identified.

The radiographic parameters significantly changed postoperatively except the C1-2 midlines' intersection angle in the TLS group ($p = 0.073$) and posterior atlanto-dens interval in both groups ($p = 0.283$, $p = 0.271$, respectively). The difference in bilateral odontoid lateral mass interspaces at last follow-up was better corrected in the TLS group than in the PS group ($p = 0.010$). Postoperative PROs had significantly improved in both groups (all $p < 0.05$). Thereinto, NDI at last follow-up was significantly lower in the TLS group compared with PS group ($p = 0.013$). In addition, blood loss and operative time were obviously lesser in TLS group compared with PS group ($p = 0.010$, $p = 0.004$, respectively). Multivariable regression analysis revealed that a change in C1-C2 sagittal Cobb angle was independently correlated to PROs improvement (NDI: $\beta = -0.435$, $p = 0.003$; JOA score: $\beta = 0.111$, $p = 0.033$; SF-36 PCS: $\beta = 1.013$, $p = 0.024$, respectively), also age ≤ 40 years was independently associated with NDI ($\beta = 5.40$, $p = 0.002$).

Three-planar AAI should be reconstructed by C1 LMS-C2 PS fixation, while sagittal or coronal AAI could be corrected by C1 LMS-C2 TLS fixation. PROs may improve after atlantoaxial reconstruction in patients with chronic AAI. The C1-2 Cobb angle is an independent predictor of PROs after correcting chronic AAI, as is age ≤ 40 years for postoperative NDI [2].

1)
Du YQ, Li T, Ma C, Qiao GY, Yin YH, Yu XG. Biomechanical evaluation of two alternative techniques to the Goel-Harms technique for atlantoaxial fixation: C1 lateral mass-C2 bicortical translaminar screw fixation and C1 lateral mass-C2/3 transarticular screw fixation. J Neurosurg Spine. 2020 Jan 17:1-7. doi: 10.3171/2019.11.SPINE191178. [Epub ahead of print] PubMed PMID: 31952043.
2)
Pan Z, Xi Y, Huang W, Kim KN, Yi S, Shin DA, Huang K, Chen Y, Huang Z, He D, Ha Y. Independent Correlation of the C1-2 Cobb Angle With Patient-Reported Outcomes After Correcting Chronic Atlantoaxial Instability. Neurospine. 2019 Jun;16(2):267-276. doi: 10.14245/ns.1836268.134. Epub 2019 Jun 30. PubMed PMID: 31261466.

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