Does Muscle Matter? A New Perspective on Cervical Sarcopenia and Its Associations with Non-Improvement After Anterior Cervical Discectomy and Fusion

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INTRODUCTION: Preoperative cervical muscle health may be associated with patient-reported outcomes (PROMs) after anterior cervical discectomy and fusion (ACDF). Poor cervical muscle health (sarcopenia), is often defined as low cross-sectional area (CSA) and increased fat infiltration (FI), though studies differ in the muscles and metrics analyzed. Of note, low CSA and high FI may not be correlated, and there is no accepted definition of cervical sarcopenia. Our purpose was to create a comprehensive definition of cervical muscle health using FI and CSA from multiple cervical muscle groups. We also investigated associations between cervical sarcopenia and patient improvement after ACDF.

METHODS:

This retrospective cohort study included patients who underwent primary 1- or 2-level ACDF, had preoperative T2 cervical magnetic resonance imaging within 6 months of surgery, minimum 1-year follow-up, and global rating of change (GRC) at postoperative 6 months, 1 or 2 years. Patients < 18 years, revisions, and hybrid constructs were excluded. Demographics (age, sex, race, body mass index [BMI], age-adjusted Charlson Comorbidity Index [CCI]), comorbidities, perioperative variables, PROMs (neck disability index [NDI], visual analog scale [VAS] for neck and arm pain), PROMs minimal clinically important difference (MCID), GRC, muscle CSA, and FI (modified Goutallier) were collected. Cohorts were defined by GRC improvement $\geq$ 6 months. CSA was measured at C5-C6 for deep flexors/DF (longus colli, longissimus capitis), deep extensors/DE (multifidus, semispinalis cervicis, spinalis cervicis), superficial extensors/SE (splenius capitis, splenius cervicis, semispinalis capitis, splenius colli), trapezius/trap, levator scapulae/LS, and sternocleidomastoid/SCM. Muscles were clustered as: flexors (DF), extensors (DE + SE), and other (trap, LS, SCM). CSA was normalized to height-squared. “Low muscle health” of individual muscles or groups was defined as total normalized CSA lower than the lowest quartile of sex-adjusted normalized CSA of the whole sample. A scoring system for low overall muscle health was made: 1 point for: “low muscle health” of the (1) flexors (2) extensors (3) other muscle groups or (4) C5-C6 DE Goutallier $\geq$ 2. Low overall muscle health was defined as scoring greater than 2 out of 4. Early (2, 6, 12 weeks) and late (6 months, 1 year, 2 years) postoperative windows were analyzed for PROMs. The latest time point in each window was used. Wilcoxon rank-sum, Fisher exact, and intraclass correlation coefficient (ICC) were used. Logistic regression was conducted for predictors of GRC improvement at 6 months or later.

RESULTS: 263 patients were included. 216 (82.1%) reported improvement. There were no significant differences in demographics, comorbidities, or preoperative PROMs. The improvement cohort had significantly shorter preoperative symptom duration (83.8 vs 129.8 weeks, p = 0.003), better early (VAS neck, VAS neck/arm MCID), and late (all) PROMs. ICC was excellent overall (>0.90). There were no significant differences in muscle health of individual muscles or groups. The improvement cohort had fewer patients with low overall muscle health (11.1% vs 25.6%, p = 0.024). Regression covariates included age, sex, CCI, preoperative symptom duration, and low overall muscle health; low overall muscle health remained significantly associated with non-improvement (Adjusted OR: 2.79 [1.1537 - 6.7354], p = 0.023).

DISCUSSION AND CONCLUSION: This study created a novel scoring system to define low overall cervical muscle health using multiple cervical muscles and measures of fatty infiltration. Results showed that low overall muscle health is associated with non-improvement after primary ACDF.