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Review

Comparison of anterior cervical discectomy and fusion with the zero-profile device versus plate and cage in treating cervical degenerative disc disease: A meta-analysis

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ABSTRACT

Zero-profile device was applied to diminish the irritation of the esophagus in the treatment of cervical degenerative disc disease. However, the clinical application of the zero-profile device has not been testified with clinical evidence. The aim of the meta-analysis was to systematically compare the safety and effectiveness of anterior cervical discectomy and fusion with zero-profile device with plate and cage for the treatment of cervical degenerative disc disease. Electronic searches of PubMed and Embase were conducted up to May 2015. Relevant studies were included. Weighted mean difference (WMD) and 95% confidence intervals (CI) were assessed for continuous data. Risk ratio (RR) and 95% CI were assessed for dichotomous data. P value <0.05 was considered to be significant. Eleven studies were included in the meta-analysis. Compared with plate and cage, zero-p is associated with lower operation time of two-level surgery, less intraoperative blood loss, higher subsidence rate, higher JOA score, lower incidence of dysphagia in short-term (RR: 0.72, 95% CI [0.58, 0.90], $P = 0.005$, $I^2 = 22\%$) and long-term (RR: 0.12, 95% CI [0.05, 0.30], $P < 0.00001$, $I^2 = 0\%$) and lower Cobb angle of multilevel surgery (WMD: −3.16, 95% CI: [−4.35, −1.97], $P < 0.00001$, $I^2 = 0\%$). No significant difference was found in one-level and two-level Cobb angle, fusion rate and operation time of one-level and three-level surgery. Both zero-p implantation and the plate and cage have respective advantages and disadvantages.

1. Introduction

Cervical degenerative disc disease (CDDD) is one of the main causes of myelopathy and rediculopathy. Anterior cervical discectomy and fusion (ACDF) is considered as the gold-standard procedure [1] when conservative therapy fails, as was initially described by Smith [2] and Cloward [3] in 1950s. Due to the numerous donor site complications such as iliac crest fracture, hematoma and infection [4–7], autologous iliac bone graft has been replaced by allograft or synthetic cages.

The anterior cervical plate has been gradually applied to promote fusion rate, enhance rigidity of fixation, improve sagittal alignment and prevent the dislocation of interbody graft [6,8–10]. However, the addition of the anterior cervical plate would lead to some other complications such as tracheo-esophageal injuries, adjacent level degeneration, soft tissue injury and increased incidence of dysphagia [11–13]. The reported incidence of dysphagia in the early postoperative period varies from 2% to 67% [14–19]. For the majority of patients, the dysphagia disappeared within 3 months after surgery. But the others (about 3–35.1% of the patients) still suffer from dysphagia. [11,14,18,20–23].

The zero-profile device (zero-p), which not only provides immediate stability but also prevents the plate related dysphagia [24,25], was applied in clinical practice to diminish the irritation of the esophagus.

This article aims to perform a meta-analysis to compare the clinical efficacy, radiologic outcomes and incidence of complications between ACDF with "zero-p" and "plate and cage" in treating patients with CDDD.

2. Materials and methods

2.1. Search strategy

Electronic searches of PubMed and Embase (update to May 31, 2015) were conducted by using the combination of the following terms: "zero-profile" or "zero-p" or "SAAS" or "stand-alone anchored spacer" or "anchored cage" or "anchored spacer" or

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"no-profile" and "cervical". Only English studies were included. Reference lists of relevant articles were also reviewed for potentially relevant studies. Repetition of information can be avoided by means of retaining only the largest one in studies with overlapping patients, and the corresponding criteria included hospital, study period and treatment information.

2.2. Inclusion and exclusion criteria

Researches that met the following criteria were included: (1) original articles; (2) researches comparing the clinical and radiological outcomes between the ACDF with zero-p and plate and cage; (3) patients were clinically confirmed of degenerative disease of cervical spine in need of surgical intervention; (4) researches with follow-up of more than 6 months. Researches that met the following criteria were excluded: (1) researches that did not report both ACDF with zero-p and plate and cage; (2) human cadaveric studies; (3) unrelated researches; (4) literature review or meta-analysis; (5) case reports; (6) conference abstracts.

2.3. Data extraction

The information required was extracted by two of the authors independently from eligible studies, which includes: (1) author and year of publication; (2) country; (3) study design; (4) sample size; (5) intraoperative blood loss; (6) operation time; (7) incidence of dysphagia; (8) Japanese Orthopaedic Association (JOA) scores; (9) duration of follow-up; (10) cervical Cobb angle; (11) segmental Cobb angle and (12) subsidence rate.

2.4. Quality assessment

The quality of included ten observational studies were independently assessed by two authors using the Newcastle-Ottawa quality assessment scale (NOS). The NOS uses a star system (ranging from 0 to 9 stars) to evaluate the quality of case-control studies and cohort studies. Studies with a score of 7–9 were regarded as high quality. The quality of one included randomized controlled trial (RCT) was independently assessed by two authors using the Delphi list.

2.5. Statistical analysis

The meta-analyses were performed using Review Manager software (RevMan 5.3; Cochrane Collaboration) and the STATA 13.0 (StataCorp LP, College Station, TX, USA). Weighted mean difference (WMD) and 95% confidence intervals (CI) were assessed for continuous data (intraoperative blood loss, operation time, JOA scores and RR of JOA score and cervical Cobb angle). Risk ratio (RR) and 95% CI were assessed for dichotomous data (incidence of dysphagia and subsidence rate). A probability of P less than 0.05 was considered to be statistically significant. I^2 statistic (ranging from 0 to 100%) was used to assess the heterogeneity of included studies. I^2 statistic >50% was considered as obvious heterogeneity, under which circumstance, random effects analysis would be performed. When heterogeneity was not significant (I^2 statistic $\leqslant$50%), the fixed effects analysis would be performed. The publication bias was assessed through the "Metabias" procedure of STATA 13.0, which consists of two approaches, Begg's and Egger's tests. Trim-and-fill analysis was used to investigate possible publication bias.

3. Result

3.1. Identification of relevant studies

Ninety-four studies were identified by searching in PubMed and Embase. After removing of duplicate studies, 64 articles were retrieved. Nineteen unrelated studies, one literature review, one case report, five conference abstracts, 10 human cadaveric studies, one not written in English and 12 non-comparative studies, were excluded. Five studies [26–30] were conducted at the same institution, and we selected one article, for the patients studied may have overlapped. Eventually, 11 studies were eligible for the meta-analysis. A flow diagram of literature search strategy for relevant studies is shown in Figure 1.

3.2. Characteristics of included studies and quality assessment

Two RCT, one prospective study and eight retrospective studies were identified. The characteristics of the included studies and patients are presented in Table 1. There were 360 patients treated with ACDF with zero-p and 378 patients with plate and cage. Each included observational study was assessed according to NOS, which is shown in Table 2. The mean score (ranging from 7 to 9) of included studies was 8. All included studies were regarded as high quality. The included RCTs were assessed according to Delphi list, which is shown in Table 3.

3.3. Meta-analysis of outcomes

3.3.1. Operation time

Eight studies with 176 patients in the zero-p group and 194 patients in the plate and cage group were included in the meta-analysis of operation time in one-level, two-level and three-level surgery. No significant difference was found in one-level surgery (WMD: −0.92, 95% CI: [−9.33, 7.50], $P = 0.83$, $I^2 = 92\%$, Fig. 2) and three-level surgery (WMD: −8.94, 95% CI: [−52.93, 35.04], $P = 0.69$, $I^2 = 96\%$, Fig. 2). While significant difference was identified in two-level surgery (WMD: −19.38, 95% CI: [−28.34, −10.41], $P < 0.0001$, $I^2 = 0\%$, Fig. 2). However, obvious heterogeneity was

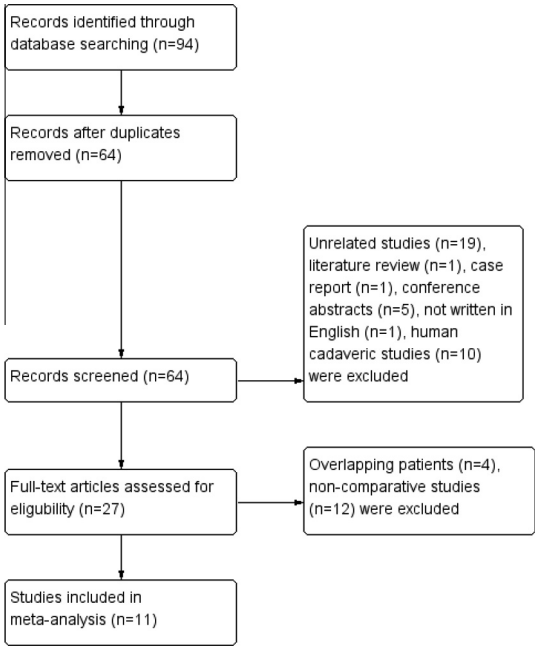

Fig. 1. Flow diagram of study selection.