

Adjacent segment disease after anterior cervical discectomy and fusion

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Abstracts

Purpose

to evaluate adjacent segment disease in relation to altered biomechanics or represents the natural history of aging process of cervical spondylosis at the adjacent segment.

Patient and method

retrospective study of 20 patients after 5 years from anterior cervical discectomy and fusion had been operated in, El-Helal and, El-Azhar university hospitals Cairo, Egypt . The study was approved by the ethics committee of our institute.

Results

at the end of patients follow up we found that the more the age of patients the earlier development of ASD and the more the time of the operation the earlier development of ASD.

Conclusion

adjacent segment disease is mechanical insult leading to acceleration of aging process in adjacent levels of fusion.

Kay Words

ACDF: anterior cervical discectomy and fusion, ASDeg: adjacent segment degeneration, ASD: adjacent segment disease, CDA: cervical disc arthroplasty.

Introduction

Adjacent segment disease (ASDis) is defined as new degenerative changes at a spinal level adjacent to a surgically treated level or levels in the spine, accompanied by related symptoms (radiculopathy, myelopathy, or instability); but adjacent segment degeneration (ASDeg) represents the radiographic changes without the symptomatology like osteophyte formation, intervertebral disc degeneration, spinal stenosis, segmental instability, facet arthrosis or significant structural deformity [1].

The pathology of adjacent segment disease is still a question that does this pathology due to this biomechanical more stress or it is normal aging degeneration, but recent studies recommend that it is biomechanical degeneration [2].

The area of the cervical spine where most fusions occur (C3–C7) is adjacent to a highly mobile upper cervical region, and this contributes to the biomechanical stress put on the adjacent cervical segments post fusion. Studies have shown that after fusion surgery, there is increased load and stress on adjacent seg-

ments[3].

Mainly adjacent segment disease affect the upper level may be due to increase mobility in upper levels which increase biomechanical insult or may be due to technical faults in the operation due to long anterior plate which injure the upper level[4].

Science five decades the adjacent segment disease became a very important topic due to significant increase in fusion surgery and development of motion preservation technologies that theoretically should decrease this pathology[5].

Motion preservation surgeries like cervical disc arthroplasty (CDA) which are more difficult and more expensive were established only to decrease degenerative changes by decreasing biomechanical insult to the adjacent levels[6].

Aim of the study

To evaluate adjacent segment disease in relation to altered biomechanics or represents the natural history

of aging process of cervical spondylosis at the adjacent segment.

Patient and method

Retrospective study of 20 patients after 5 years from anterior cervical discectomy had been operated in, El-Helal and, El-Azhar university hospitals Cairo, Egypt ,in the period from November 2016 till July 2018. The study was approved by the ethics committee of our institute.

Inclusion criteria:

- Skeletally mature patients.
- Good post-operative result.
- Patients with only anterior fusion.

Exclusion criteria:

- Patients with congenital anomalies in cervical spine.
- Patients with rheumatic diseases.
- Patients with cervical tumors.

Methodology:

Data

Data are to be collected from patient records and surgical notes; including: Demographic data, Environmental data, Surgical approach & Technique.

Patient Interview

Patient interview including:

The clinical examination: can the patient adapt pressure symptoms (neck pain, radiculopathy or myelopathy) or not, and pain will be measured according to verbal numerical rating scale for pain.

Radiographic examination: plain x-ray lateral view and MRI to patients.

Results

At the end of patients follow up we found that the more the age of patients the earlier development of ASD and the more the time of the operation the ear-

lier development of ASD.

In the following master sheet, we match between age by years, time of surgery by hours, post-operative neck pain according to numeric rating scale for pain, post-operative radiculopathy and myelopathy if present it will have score 1 and if not, it will have score 0, post-operative x-ray according to Kellgren score, post-operative MRI according to Eduardo Barros Puertas score, time at which manifestations of ASD started and 5 years post-op neck pain, radiculopathy, myelopathy, x-ray and MRI according to previous score of each one.

According to previous master sheet the statistical comparison between age of patient and time at which ASD manifestations started was as the following: -

Correlation value (paired -t-test): -0.979

P-value: <0.0001

Confidence interval: 95%

According to previous master sheet the statistical comparison between duration of the operation and time at which ASD manifestations started was as the following: -

Correlation value (paired -t-test): -0.732

P-value: 0.0001

Confidence interval: 95%

This statistics mean that age as well as mechanical insult lead to development of ASD, so it's mechanical insult accelerating normal aging process of cervical spine degeneration.

Case presentation

Case 1:

- Female patient 50 years old underwent ACDF 5 years ago.
- Pre-operative symptoms were neck pain and radiculopathy to right upper limb.
- Radiological examination showed C5-6 disc bulge.
- Post-operative the patient had neither neck pain nor radiculopathy.
- After 4.5 years she complained from neck pain and radiculopathy left upper limb.

Age	duration of the operation by hours	Post-op pain	Post-op radiculopathy	Post-op Myelopathy	Post-op X-ray at adjacent level	Post-op MRI at adjacent level	Time at which ASD manifestations started post-op	Neck pain 5 years Post-op	Radiculopathy 5 years Post-op	Myelopathy 5 years Post-op	5 years Post-op X-ray at adjacent level	5 years Post-op MRI at adjacent level
50	2:00	2	0	0	1	1	4.5 years	8	1	0	4	4a
52	2:00	1	0	0	1	1	4.5 years	9	1	0	4	4a
52	2:30	0	0	0	1	1	4.25 years	9	1	0	4	5
53	2:15	0	0	0	0	1	4.25 years	9	1	0	4	4a
53	2:45	0	0	0	1	1	4 years	10	1	1	4	4b
54	2:30	1	0	0	1	1	4 years	9	1	0	3	4b
55	2:20	1	0	0	1	1	4 years	9	1	0	4	5
57	2:35	1	0	0	1	1	3.75 years	9	1	0	3	4b
58	2:00	2	0	0	1	1	3.5 years	10	1	0	3	4a
60	2:30	0	0	0	1	1	3.5 years	9	1	1	3	4b
60	2:50	2	0	0	0	2	3.5 years	10	1	0	4	5
62	2:30	2	0	0	1	2	3.5 years	9	1	0	4	4b
65	2:15	1	0	0	1	2	3 years	10	1	0	4	5
65	2:30	1	0	0	1	1	3 years	9	1	1	4	5
69	2:40	1	0	0	1	2	2.75 years	9	1	1	4	4b
70	3:15	2	0	0	1	2	2.75 years	10	1	0	3	4b
71	3:30	1	0	0	1	2	2.75 years	9	1	0	4	5
73	2:50	2	0	0	1	1	2.5 years	9	1	1	4	4b
73	3:40	1	0	0	1	1	2.5 years	10	1	1	4	5
77	3:30	2	0	0	1	2	2.5 years	10	1	1	4	5



Fig 1: Pre-operative MRI of the patient showing C5-6 disc bulge



Fig 2: Post-operative x-ray AP and lateral views



Fig 3: 5 years post-operative x-ray and MRI showing degeneration at two levels above and level below

Case 2:

- Female patient 53 years old underwent ACDF 5 years ago.
- Pre-operative complain was neck pain and left upper limb radiculopathy.
- Radiological assessment showed C4-5 disc bulge.
- She underwent ACDF at level C4-5 and her symptoms improved.
- 4.25 years post-operative, the patient complains from neck pain and right-side radiculopathy with positive Spurling test and myelopathy with positive Hoffman's test.



Fig 5: Post-operative x-ray showing ACDF at level C4-5



Fig 4: Pre-operative MRI showing C4-5 disc



Fig6: 5 years post-operative x-ray showing narrowing disc space and large osteophytes at level above and level below C4-5 fusion.



Fig 7: 5 years post-operative MRI showing C4-5 fusion with degenerated level above and two levels below leading to cord malacia

Discussion

This study depended on the relation between age, surgical duration and time ASD manifestations started to detect that is the age of the patient is the only factor that lead to ASD or mechanical insult plays a role.

According to the statistics there is a significant relation between age of the patient and ASD as well there is significant relation between duration of the surgery and ASD.

This lead to the conclusion that ASD is a biomechanical insult leading to acceleration of aging process.

Jawahar, A et al (2010) [7] reported that there is no mechanical insult in ASD and there is no outcome difference between ACDF and disc arthroplasty but this study didn't respect the age of the patients and the study depended on short time follow up (one year) not prolonged follow up like this study (5-10 years).

Ishihara, H. et al (2004)[8] reported that the ASD is only aging process. They depended on the different outcome between single level fusion and multiple level fusion.

Wang, H et al (2017)[9] reported that there is significant increase in ASD in 2 level fusion than in one level fusion and in upper cervical level fusion than in lower less mobile cervical fusion with no age or body mass index (BMI) different results; but this study was made by two years follow up after operation only.

Bevevino, A.J. and A.S. Hilibrand (2016)[10] reported that ASD is multifactorial and related to age, type of operation, time passed from operation and BMI of the patient.

McConnell, J.R., et al. (2016)[11] reported that the

ASD is a biomechanical insult. They depended on the incidence of ASD after ACDF comparing with CDA.

Donk R.D., et al. (2018)[12] in a prospective study on 142 patients reported that the method of fixation has a significant effect on ASD as ACDF with cage only has less incidence of ASD than plating. They reported that the incidence of ASD is 0.7%.

Luo J, et al. (2015)[13] in meta-analysis study of 8 prospective studies reported that there is a significant low rate of ASD in CDA than ACDF due to biomechanical causes.

Lee J.C., et al. (2014)[14] in a retrospective study of 1358 patients reported that anterior and posterior fusion has more rate of ASD than ACDF or posterior fixation alone. This prove the biomechanical effect on ASD and give conclusion that the more rigid fixation the more incidence of ASD.

Miller J., et al (2018)[15] in a prospective study on 79 patients and their follow up after 1,2,4 and 7 years reported that there is no deference in ASD incidence between ACDF and CDA which means that there is no biomechanical cause for ASD. This odd result may be due to neglecting age variance between these patients.

Y Zhu, et al. (2016)[4] in a meta-analysis study reported that CDA has less incidence of ASD than ACDF. This is due to motion preservation in CDA which decrease biomechanical insult than ACDF.

According to the results of this study and the results of these papers which mostly prove that motion preservation techniques have less incidence of ASD than ACDF and aging affects ASD the ASD is a biomechanical insult leading to acceleration of aging process.

Conclusions:

- ASD is a biomechanical insult leading to acceleration of normal aging process.
- Motion preservation techniques are preferred on fusion specially in upper cervical segments which are more mobile.
- ACDF is not the best choice for younger individuals except in presence of instability.
- Fusion by less rigid methods like cage is preferred on fusion by more rigid methods like plate or lateral mass screws and rods.
- High rate of ASD among younger individuals may be due to technical faults like long plate that irritate disc or facet injury in posterior fixation.

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