Volume: 27, Issue: 4, July 2016 pp: 209/212 ORIGINAL ARTICLE / ORJİNAL MAKALE

LUMBAR FACET JOINT ANGLES: A MORPHOMETRIC STUDY

LOMBER FASET EKLEM AÇILARI: MORFOMETRİK ANALİZ

Selçuk ÖZDOĞAN[1],
Eyüp Can SAVRUNLU[2],
Erek ÖZTÜRK[2],
Elif Evrim ÖNER[3],
Erdinç CİVELEK[4],
Serdar KABATAŞ[4]

[1] *Surgeon of Neurosurgery, Department of Neurosurgery, Gaziosmanpaşa Taksim Training and Research Hospital, Istanbul.*

[2] *Resident, Department of Neurosurgery, Gaziosmanpaşa Taksim Training and Research Hospital, Istanbul.*

[3] *Specialist of Radiology, Department of Radiology, Gaziosmanpaşa Taksim Training and Research Hospital, Istanbul.*

[4] *Assoc. Prof. of Neurosurgery, Department of Neurosurgery, Gaziosmanpaşa Taksim Training and Research Hospital, Istanbul.*

Corresponding Author:
Selçuk ÖZDOĞAN
Address: Gaziosmanpaşa Taksim Eğitim ve Araştırma Hastanesi Karayolları Mahallesi, Osmanbey Caddesi, 621. Sokak, No.10, Gaziosmanpaşa, İstanbul, Türkiye.
Tel: +90 506 763 71 73
Fax: +90 212 945 31 78
E-mail: drselcukozdogan@hotmail.com
Received: 12th July, 2016.
Accepted: 18th September, 2016.

SUMMARY:

Introduction: Our aim is to make a database of lumbar facet joint angles to understand the mean values and standard deviations so we can predict the values in lumbar facet joint pathologies.

Materials-Methods: We investigated the Magnetic Resonance Imaging (MRI) scans of lumbar spine obtained in adult patients (n=202) who were admitted to our hospital for emergency and outpatient clinics retrospectively. Facet joint angles were measured on axial images of MRI according to Grobler's method.

Results: 202 patients (102 females, 50.49 %, and 100 males, 49.51 %, respectively) were included in the study. Accordingly, mean age of female was 37,03 ± 11,52 years and male was 37,55±11,53 years, respectively. None of the variables were found to be significantly different between genders (p>0.05).

Conclusion: We tried to evaluate the mean values of facet joint angles in lumbar vertebras in order to make a database for the comparison studies that investigate the pathologies of facet joints and other spinal diseases.

Key words: Facet joint angle, Lumbar vertebras, Magnetic Resonance Imaging.

Level of evidence: Retrospective clinical study, Level III.

ÖZET:

Giriş: Çalışmadaki amacımız lomber faset eklem açılarından bir veri tabanı oluşturarak ortalama ve standart değerleri anlamak ve bu sayede lomber faset eklem patolojilerindeki değerleri öngörebilmektir.

Materyal-Metot: Acil servise ve polikliniğe başvuran 202 adet erişkin lomber spinal Manyetik Rezonans Görüntüleme (MRI) imajları geriye dönük olarak incelendi. Faset eklem açıları MRI aksiyel görüntüleri kullanılarak Grobler metodu ile ölçüldü.

Bulgular: Çalışmaya 202 hasta (sırasıyla 102 kadın, % 50.49 ve 100 erkek, % 49.51) katıldı. Sırasıyla kadınların ortalama yaşı 37,03 ± 11,52 ve erkeklerin ortalama yaşı 37,55 ± 11,53 olarak hesaplandı. Ölçülen değerler açısından cinsiyetler arasında anlamlı bir fark saptanmadı (p>0.05).

Sonuç: Lomber faset eklem açılarının ortalama değerleri ile bir veri tabanı oluşturarak faset eklem ve diğer spinal hastalıklar gibi patoloji çalışmalarında kullanılması hedeflenmiş ve açı değerlerinin Türk toplumunda da literatürle uyumlu olduğu fikri elde edilmiştir.

Anahtar kelimeler: Faset eklem açısı, Lomber vertebralar, Manyetik Rezonans Görüntüleme

Kanıt Düzeyi: Geriye dönük klinik çalışma, Düzey III.

INTRODUCTION:

Facet joint pain constitutes a substantial proportion of spinal pain, which increases in prevalence especially in the elderly. The prevalence of lumbar facet joint pain is 16 % to 41 %. In the cervical spine, the prevalence is 36 % to 67 %, in the thoracic spine the prevalence is 34 % to 48 %[20].

The abnormal motion associated with spondylolisthesis, vertical loading from disc degeneration and arthritis can be the cause of facet joint degeneration similar to that seen in other synovial joints[15,18]. Pain could be the result of an osteophyte impinging on a nerve, a capsule being stretched, synovial villi being trapped within articular surfaces, and chemicals that cause an inflammatory reaction[13,16]. Facet joints also have been shown to be richly innervated by the medial branches of the dorsal rami[2,26]. Neuroanatomic and biomechanical studies have shown that facet joints have both free and encapsulated nerve endings; they also have nerves that contain substance P and calcitonin gene-related peptide[6-7].

Our aim is to make a database of lumbar facet joint angles to understand the mean values and standard deviations so we can predict the values in lumbar facet pathologies.

MATERIAL AND METHOD:

We inspected the Magnetic Resonance Imaging (MRI) scans of lumbar spine that obtained in adult patients (n: 202) who were admitted to our hospital for emergency and outpatient clinics retrospectively. Inclusion criteria's for patients in the study are; - patients had to be between the ages of 18 – 60 years old, have undergone a MRI of the lumbar vertebra and had no pathological spinal trauma or spinal disease. Patients were excluded if their radiological examinations were not sufficient for the proposed measurements or if they were known to have pathological conditions of the lumbar spine.

Facet joint angles were measured on axial images of MRI according to Gobbler's method[14]. A line was drawn to join two points determined in the most posterior of the vertebral body. Then two anterior and posterior points in the inner surface of the facet joint was determined and the joining line was withdrawn to the former coronal line and the angle was measured (Figure-1)[14,24].

Statistical Analyses:

Descriptive data were presented as mean and standard deviations for numerical variables. Independent group comparisons were analyzed with Mann-Whitney U test between genders. A Type I error level of 5 % was considered as statistical significance in analyses. SPSS 18 (IBM Inc., Armonk, USA) was used for the statistical assessments.

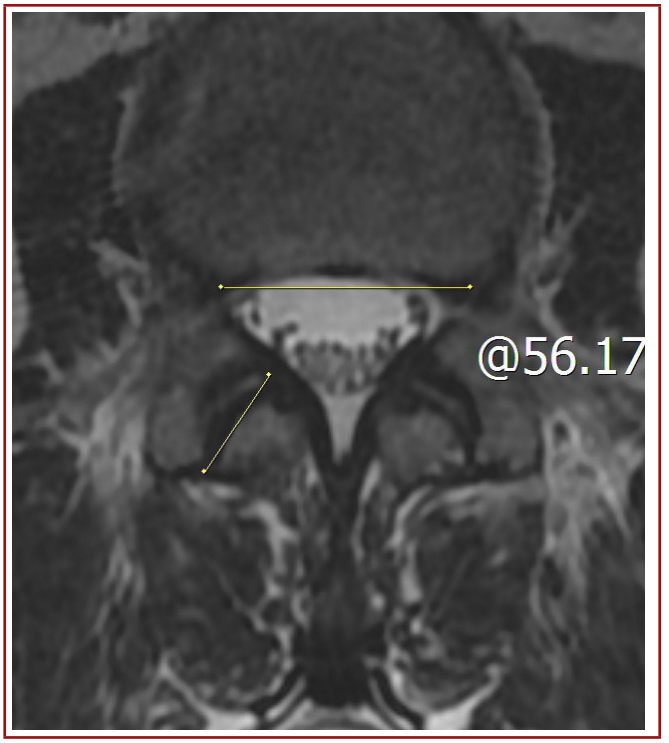

Figure-1. L_4 facet joint angle measurement with Grobler's method.

RESULTS:

202 patients (102 females, 50.49 %, and 100 males, 49.51 %, respectively) were included in the study. Accordingly, mean age of female was 37,03 ± 11,52 years old and male was 37,55 ± 11,53 years old, respectively. The mean facet joint angle values are presented at Table-1. None of the variables were found to be significantly different between genders (p>0.05).

Table-1. Mean values of lumbar facet joint angle

	Male	Female	p
	Mean±SD	Mean±SD	
AGE	37,55±11,53	37,03±11,52	0,929
L1-Right	60,08±9,61	61,3±7,78	0,525
L1-Left	57,57±8,82	58,44±8,31	0,886
L2-Right	58,84±10,09	59,3±9,5	0,986
L2-Left	54,35±7,25	55,54±7,05	0,560
L3-Right	54,39±7,75	53,26±7,12	0,747
L3-Left	51,69±9,03	48,2±7,26	0,098
L4-Right	47,49±11,68	46,66±4,49	0,132
L4-Left	43,77±10,28	41,14±8,05	0,361
L5-Right	41,65±12,33	37,29±10,26	0,162
L5-Left	43,82±9,47	44,62±5,29	0,045

DISCUSSION:

Facet arthropathy is presented with a progressive pain, rather than an acute process[3,8]. Patients with facet joint pain are typically older, with patients younger than 50 years being more likely to present with discogenic pain or a centralized pain phenotype[4]. Physical examination finding of facet arthropathy is paraspinal tenderness[9,10]. Radiological studies proved that disc degeneration precedes the development of degeneration in facet joints with increasing age[5,12]. Facet arthropathy is commonly observed in advanced imaging studies in all spinal regions, even in asymptomatic volunteers[22,30].

The rationale of facet joints as a pain source is established by their abundant innervation[1,11]. The facet joints could be the cause of spinal axial pain and referred pain in the extremities and chest wall[21,23]. In the literature, there are many studies show the correlation of facet joint pain with demographic features, pain characteristics, physical findings, and specific signs or symptoms[11,19]. In addition, referral patterns for joints are variable that facet joint pain can be produced by many other structures in the spine[19,25,28-29]. Consequently, controlled local anesthetic blocks of spinal facet joints or medial branch blocks are employed to diagnose facet joint pain.

The morphology of facet joint had been discussed in many studies in the literature. In our study, we measured the angles of lumbar vertebra facet joints to understand the mean values. If we know the mean values, it can be useful to understand the pathological values that associated with diseases. Naderi et al. inspected that facet joint angle was increasing with protruded and extruded disc herniations on L_{4-5} level when they compared with the control group[24]. Their measurement technique was the same with ours but they measured on computed tomography. Loback et al. studied facet joint angle and disc herniation and they found asymmetric facet joint in central disc herniations and a facet tropism in lateral disc herniations[17]. On the other hand Van Schaik et al. studied orientation and shape of facet joint with low back pain but he founded no correlation between side of disc herniation and the facet joint tropism[27].

We tried to evaluate the mean values of facet joint angles in lumbar vertebras in order to make a database for the comparison studies that investigate the pathologies of lumbar facet joints and other spinal diseases as well.

REFERENCES:

1. Atluri S, Singh V, Datta S, Geffert S, Sehgal N, Falco FJE. Diagnostic accuracy of thoracic facet joint nerve blocks: An update of the assessment of evidence. *Pain Physician* 2012; 15: E483-E496.
2. Barnsley L, Bogduk N. Medial branch blocks are specific for the diagnosis of cervical zygapophyseal joint pain. *RegAnesth* 1993; 18: 343-350.
3. BarnsleyL, Lord SM, Wallis BJ, Bogduk N. The prevalence of chronic cervical zygapophysial joint pain after whiplash. *Spine* 1995; 20: 20–25.
4. Brummett CM, Clauw DJ. Fibromyalgia: a primer for the anesthesia community. *Curr Opin Anaesthesiol* 2011; 24: 532–539.
5. Butler D, Trafimow JH, Andersson GB, McNeill TW, Huckman MS. Discs degenerate before facets. *Spine* 1990; 15: 111–113.
6. Cavanaugh JM, Lu Y, Chen C, Kallakuri S. Pain generation in lumbar and cervical facet joints. *J Bone Joint Surg* 2006; 88-A: 63-67.
7. Cavanaugh JM, Ozaktay AC, Yamashita T, Avramov A, Getchell TV, King AI. Mechanisms of low back pain: A neurophysiologic and neuroanatomic study. *Clin Orthop Relat Res* 1997; 335: 166-180.
8. Civelek E, Cansever T, Kabatas S, Kircelli A, Yilmaz C, Musluman M, Ofluoglu D, Caner H. Comparison of effectiveness of facet joint injection and radiofrequency denervation in chronic low back pain. *Turk Neurosurg* 2012; 22(2): 200-206.
9. Cohen SP, Hurley RW, Christo PJ, Winkley J, Mohiuddin MM, Stojanovic MP. Clinical predictors of success and failure for lumbar facet radiofrequency denervation. *Clin J Pain* 2007; 23: 45–52.
10. Cohen SP, Bajwa ZH, Kraemer JJ, Dragovich A, Williams KA, Stream J, Sireci A, McKnight G, Hurley RW. Factors predicting success and failure for cervical facet radiofrequency denervation: a multi-center analysis. *Reg Anesth Pain Med* 2007; 32: 495–503.
11. Falco FJE, Manchikanti L, Datta S, Sehgal N, Geffert S, Onyewu O, Singh V, Bryce DA, Benyamin RM, Simopoulos TT, Vallejo R, Gupta S, Ward SP, HirschJA. An update of the systematic assessment of the diagnostic accuracy of lumbar facet joint nerve blocks. *Pain Physician* 2012; 15: E869-E907.
12. Fujiwara, A, Tamai K, Yamato M, An HS, Yoshida H, Saotome K, Kurihashi A. The relationship between facet joint osteoarthritis and disc degeneration of the lumbar spine: an MRI study. *Eur Spine J* 1999; 8: 396–401.
13. Gellhorn AC, Katz JN, Suri P. Osteoarthritis of the spine: The facet joints. *NatRev Rheumatol* 2013; 9:216-224.

14. Grobler LJ, Robertson PA, Novotny JE, Pope MH. Etiology of spondylolisthesis. Assessement of the role played by lumbar facet joint morphology. *Spine* 1993; 18: 80-93.

15. Kalichman L, Li L, Kim DH, Guermazi A, Berkin V, O'Donnell CJ, Hoffmann U, Cole R, Hunter DJ. Facet joint osteoarthritis and low back pain in the community-based population. *Spine* 2008; 33: 2560-2565.

16. Kras JV, Dong L, Winkelstein BA. Increased interleukin-1α and prostaglandin E2 expression in the spinal cord at 1 day after painful facet joint injury: evidence of early spinal inflammation. *Spine* 2014; 39: 207-212.

17. Loback D, Young-Hing K, Cassidy JD, Tchang S. The relationship between facet orientation and lumbar disc herniation: The role of torsion in iintervertebral disc failure. *Orthop Trans* 1985; 9: 560.

18. Maataoui A, Vogl TJ, Middendorp M, Kafchitsas K, Khan MF. Association between facet joint osteoarthritis and the Oswestry Disability Index. *World J Radiol* 2014; 6: 881-885.

19. Manchikanti L, Abdi S, Atluri S, Benyamin RM, Boswell MV, Buenaventura RM, Bryce DA, Burks PA, Caraway DL, Calodney AK, Cash KA, Christo PJ, Cohen SP, Colson J, Conn A, Cordner HJ, Coubarous S, Datta S, Deer TR, Diwan SA, Falco FJE, Fellows B, Geffert SC, Grider JS, Gupta S, Hameed H, Hameed M, Hansen H, Helm II S, Janata JW, Justiz R, Kaye AD, Lee M, Manchikanti KN, McManus CD, Onyewu O, Parr AT, Patel VB, Racz GB, Sehgal N, Sharma M, Simopoulos TT, Singh V, Smith HS, Snook LT, Swicegood J, Vallejo R, Ward SP, Wargo BW, Zhu J, Hirsch JA. An update of comprehensive evidence-based guidelines for interventional techniques of chronic spinal pain: Part II: Guidance and recommendations. *Pain Physician* 2013; 16: S49-S283.

20. Manchikanti L, Manchukonda R, Pampati V, Damron KS, McManus CD. Prevalence of facet joint pain in chronic low back pain in postsurgical patients by controlled comparative local anesthetic blocks. *Arch Phys Med Rehabil* 2007; 88: 449-455.

21. Marks RC. Distribution of pain provoked from lumbar facet joints and related structures during diagnostic spinal infiltration. *Pain* 1989; 39: 37-40.

22. Matsumoto M, Fujimura Y, Suzuki N, Nishi Y, Nakamura M, Yabe Y, Shiga H.MRI of cervical intervertebral discs in asymptomatic subjects. *J Bone Joint Surg* 1998; 80-B: 19–24.

23. McLain RF. Mechanoreceptors ending in human cervical facets joints. *Spine* 1994; 5: 495-501.

24. Naderi S, Ekinci G, Bayri Y, Derakhshani S, Özgen S, Pamir MN. Facet joint angle in lumbar disc herniation. *J Turkish Spinal Surg* 1997; 8: 136-139.

25. Saal JS. General principles of diagnostic testing as related to painful lumbar spine disorders: A critical appraisal of current diagnostic techniques. *Spine* 2002; 27: 2538-2545.

26. Schulte TL, Filler TJ, Struwe P, Liem D, Bullman V. Intra-articular meniscoid folds in thoracic zygapophysial joints. *Spine* 2010; 35: E191-E197.

27. Van Schalk JPJ, Verbiest Hi Van Schaik FDJ. The orientation of laminae and facet joints in the lower lumbar spine. *Spine* 1985; 10: 59-63.

28. Yilmaz C, Kabatas S, Cansever T, Gulsen S, Coven I, Caner H, Altinors N. Radiofrequency facet joint neurotomy in treatment of facet syndrome. *J Spinal Disord Tech* 2010; 23(7): 480-485.

29. Windsor RE, King FJ, Roman SJ, Tata NS, Cone-Sullivan LA, Thmapi S, Acebey M, Gilhool JJ, Rao R, Sugar R. Electrical stimulation induced lumbar medial branch referral patterns. *Pain Physician* 2002; 5: 347-353.

30. Wood KB, Garvey TA, Gundry C, Heithoff KB. Magnetic resonance imaging of the thoracic spine. Evaluation of asymptomatic individuals. *J Bone Joint Surg* 1995; 77-A: 1631–1638.