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M. Barry
P. Livesley

Facet joint hypertrophy: the cross-sectional area of the superior articular process of L4 and L5

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M. Barry (✉) · P. Livesley
Queen Elizabeth II Hospital,
Howlands, Welwyn Garden City,
Herts AL7 4HQ, UK

Abstract With CT imaging, the lumbar facet joints are well visualised and enlargement secondary to degeneration may be noted. We measured the cross-sectional area of the superior articular process of the L5 facet joint in 100 consecutive CT scans and in 71 patients, the L4 process was also measured. We found that the mean cross-sectional area was significantly larger at L5 than at L4. Patient age and sex had no significant effect on the size at either L4 or L5. A review of the radiological reports revealed that the 13 patients with degenerative facet joints and radiologically normal discs did not have significantly larger facet joints than the 35 patients with disc disease and radiologically normal facet joints. In conclusion, the term "facet joint hypertrophy" should not be used when osteoarthritic changes are noted on CT scan, because these joints are not significantly larger than normal facet joints.

Key words Degeneration · Facet joint · Anatomy · Lumbar spine · CT

Introduction

CT imaging of the lumbar spine is important in the investigation and diagnosis of low back pain. The term "facet joint hypertrophy" is applied to lumbar facet joints enlarged as the result of osteoarthritic changes [9] and this term has been defined in a variety of ways by a number of authors [1, 4, 5].

This paper attempts to identify whether the cross-sectional area of the superior articular process of the lumbar facet joints is related to patient age or sex, or to the presence of degenerative changes in the lumbar spine.

Method

One hundred consecutive CT scans of the lumbar spine were reviewed. All scans were performed for low back pain with or without nerve root entrapment. A scan was excluded if there was any history of previous lumbar spine surgery. The CT scans were performed on a General Electric HP9000S and a set protocol was followed for each patient. Scans were at 5-mm intervals, and at each intervertebral disc the scanner gantry was tilted to produce a scan through the plane of the disc.

The superior articular processes at L4 and L5 were examined. At each level, two superior articular processes are present and these were treated independently. Measurements from the L5-S1 facet joints were not used because, in many scans, the gantry angle was not sufficient to produce an image through the plane of the disc. At each level, a reproducible reference point was used to measure the cross-sectional area; this point was the slice just proximal to the appearance of the pedicle. Usually, both facet joints could be measured on the same slice; however, on occasion, adjacent slices were used. Once the slice to be measured had been identified, the facet joint was magnified × 2.0. Using a tracker ball, the bone margin of the superior articular process was outlined with a cursor. The area contained within the outline (Fig. 1) was calculated by a program incorporated within the CT scan software, and the results expressed in square millimetres.

Statistical analysis included paired and unpaired t tests, the χ^2 test and linear regression for correlation. Significance was accepted at the $P < 0.05$ level.

Intra-observer error

All measurements were made by a single observer (M.B.) and an initial study was undertaken to confirm that this method of mea-

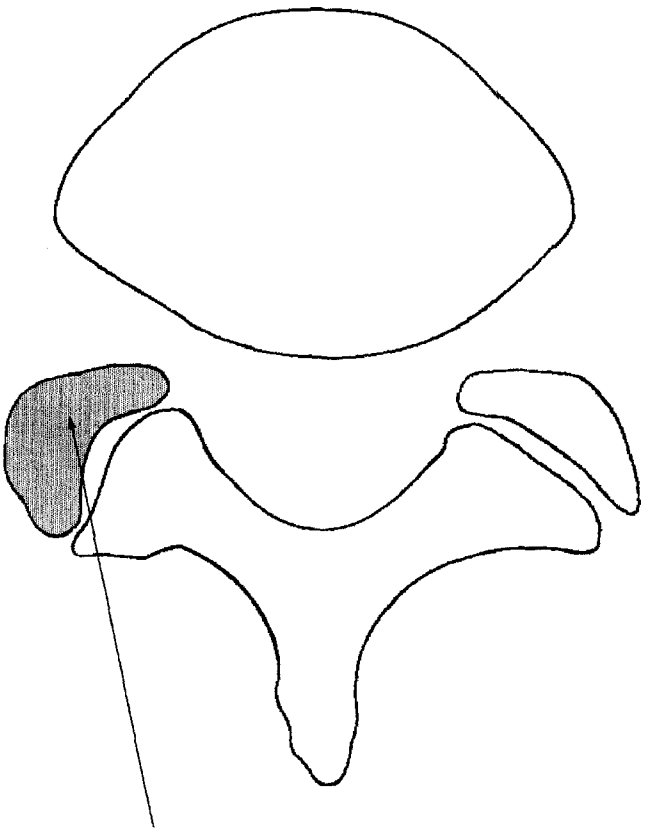

Fig. 1 Representative cross-sectional area measured at the L4-5 facet joint

surement of the cross-sectional area was consistent and accurate. For the L4 and L5 superior articular processes, there was a close correlation ($r^2 > 0.85$; $P < 0.001$) when measured on three separate occasions.

Results

Seventy-one patients had their L3-4 level imaged and all 100 patients had their L4-5 level imaged. Therefore, a total of 142 articular processes at L4 and 200 articular processes at L5 were measured. There were 57 male and 43 female patients and the overall mean age was 48 years (range: 18–81 years).

The mean area of the superior articular process at L4 and L5 is shown in Table 1. The area measured at L5 was significantly larger (t-test; $P = 0.003$) than that at L4. The results of comparisons between the right and left sides are shown in Table 2. When the measurements at both L4 and L5 were combined, there was no significant difference (t test; $P = 0.06$) between the right and left sides. Similarly at L4, there was no significant difference (t test; $P = 0.14$) between the right and left sides. At L5, however, there was a significant difference (t test; $P = 0.007$) between the sides.

Table 1 Mean cross-sectional area (± SD) of the superior articular processes of L4 and L5

Level	Mean area (mm^2)
L4 ($n = 142$)	125.2 ± 26.2
L5 ($n = 200$)	133.5 ± 25.6

Table 2 Mean cross-sectional area (± SD) of the right and left superior articular processes of L4 and L5

Level	Mean area (mm^2)	
	Right side	Left side
L4 ($n = 142$)	127.3 ± 25.6	123.4 ± 26.8
L5 ($n = 200$)	136.4 ± 26.1	130.6 ± 25.0
All ($n = 342$)	132.6 ± 26.2	127.6 ± 25.9

Table 3 Mean cross-sectional area (± SD) of the superior articular processes of L4 and L5 in the spines of male and female patients

Level	Mean area (mm^2)	
	Male patients	Female patients
L4	127.2 ± 26.7 ($n = 78$)	123.1 ± 25.6 ($n = 64$)
L5	132.7 ± 27.2 ($n = 114$)	134.6 ± 23.5 ($n = 86$)

Sex differences

At the L4 level, there were 78 male and 64 female articular processes, and at the L5 level there were 114 male and 86 female articular processes. There was no significant difference at the L4 or L5 levels between male and female measurements (t test; L4: $P = 0.36$, L5: $P = 0.6$) as shown in Table 3.

Age differences

A plot of age against the area of the superior articular process at each level shows no significant correlation (Figs. 2, 3).

Associated pathology

The radiology reports of all 100 scans were reviewed. Only two scans were entirely normal. In all other scans, abnormalities were reported in either the intervertebral discs or the facet joints or both.

On the basis of the reports, the scans were divided into three groups:

Group I: combined pathology. This was present in 51% (50/98) of patients. Abnormalities were reported in both intervertebral discs and facet joints.

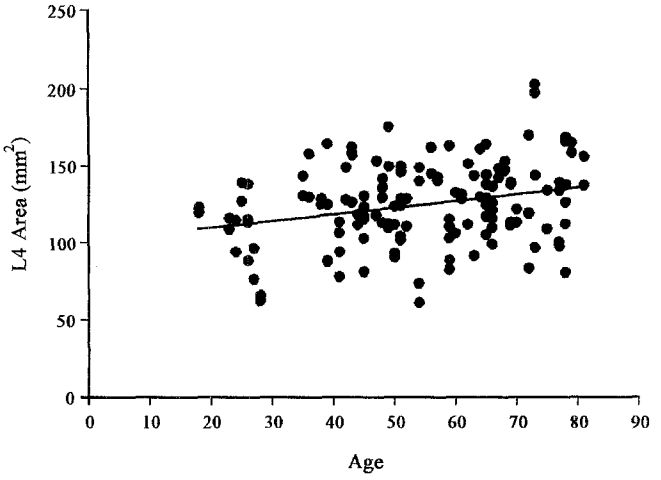

Fig. 2 Age/area correlation at L4 ($r^2 = 0.07$)

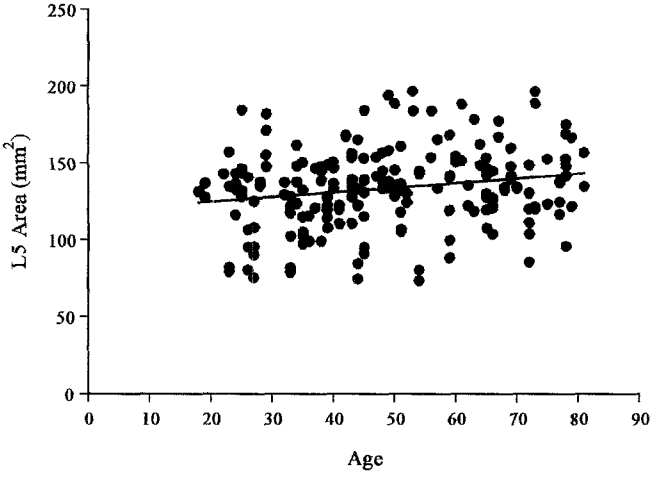

Fig. 3 Age/area correlation at L5 ($r^2 = 0.04$)

Table 4 Mean cross-sectional area (± SD) of the superior articular processes of L4 and L5 in patients with pure disc pathology (Group II) and those with pure facet joint pathology (Group III)

Level	Mean area (mm^2)		*P* value (*t* test)
	Group II	Group III	
L4	122.6 ± 29.4 ($n = 36$)	126.0 ± 30.3 ($n = 18$)	0.69
L5	132.7 ± 24.7 ($n = 70$)	120.1 ± 34.6 ($n = 26$)	0.05
Combined	129.2 ± 26.7 ($n = 106$)	122.5 ± 32.7 ($n = 44$)	0.19

Group II: disc pathology. This was present in 36% (35/98) of patients. Abnormalities were reported in the intervertebral discs, but facet joints were normal.

Group III: joint pathology. This was present in 13% (13/98) of patients. Abnormalities were reported in the facet joints, but the intervertebral discs were normal.

The cross-sectional area of the superior articular processes in patients with pure disc pathology (Group II) or pure facet joint pathology (Group III) were analysed and compared. The results are shown in Table 4. There was no significant difference (χ^2 test; $P = 0.4$) in the sex distribution between these two groups. The mean age of patients with facet joint pathology was 49 years, which was significantly older (*t* test; $P = 0.006$) than the mean age of patients with disc pathology (36 years).

Discussion

The CT morphology of normal [3] and abnormal [4] lumbar facet joints has been reported. In particular, facet joint tropism [10] and its relevance to intervertebral disc disease has been investigated [2, 7].

The cross-sectional area of the superior articular facet has been described by Panjabi et al. [8]: at L4 the mean area was 184.6 mm^2 and at L5 it was 205.5 mm^2. These areas were calculated from digitised autopsy specimens. In our study, the cross-sectional area of the superior articular process was measured from CT images, this measurement has not been previously reported. With suitable software, it is a simple measurement to make and it could be relevant in lumbar facet joint disease. This paper has shown that the cross-sectional area at L5 is significantly larger than that at L4. Although the values obtained in this study were different from those reported by Panjabi et al. [8] we would agree that the L5 process is larger, as would be expected and is consistent with the anatomy of the lumbar spine.

At L4, there was no significant difference between the right and left sides; however, there did appear to be a difference at L5. The significance of this is unclear; however, overall, there was no significant difference between the right and left sides. It might be expected that the area measured would be greater in males; however, this was not found in the results of this study.

With increasing age, facet joint degeneration is more prevalent [6]. A review of the radiology reports of the 100 patients showed that patients with radiological evidence of facet joint pathology were significantly older than those with only disc pathology. It might be expected that older patients would have larger facet joints due to the presence of degenerative joint disease, but this study has shown that there was no significant correlation between age and the area of the superior articular process at either L4 or L5. Furthermore, the cross-sectional area of the superior process in patients with CT evidence of facet joint pathology was not significantly larger than that in patients with radiologically normal facet joints. Lumbar facet joints may be reported as being "hypertrophied", but there is no clear definition in the literature [1, 4, 5] as to when a facet joint is hypertrophied and when it is not. It may be that any degenerate facet joint could be termed "hyper-

trophic", but this imprecise label is not supported by the results of this study because, when measured, degenerate lumbar facet joints at both L4 and L5 were not significantly larger than radiologically normal facet joints at the same level.

Conclusions

1. The cross-sectional area of the superior articular process of the L4 and L5 vertebrae can be reproducibly measured.

2. This area is larger at L5 than L4 and, overall, the area is not affected by side or sex.

3. There is no significant correlation between patient age and measured cross-sectional area.

4. Patients with radiological evidence of degenerative changes of the lumbar facet joints do not have significantly larger cross-sectional areas than those with intervertebral disc disease and radiologically intact facet joints.

5. "Facet joint hypertrophy" is a misnomer, because degenerate facet joints are no larger than normal facet joints.

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