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Abstract: Aims and Background: X-rays of patients with low back pain rarely show serious pathology but frequently reveal incidental age-related changes and always expose people to radiation. Patients who have X-rays are more satisfied but report worse pain and disability. Psychological factors such as illness beliefs, catastrophizing and fear avoidance have been shown to be predictors of chronicity/disability. Authorities suggest that the way X-ray information is transmitted and interpreted by patients may influence outcome, therefore this study was designed to determine the words used by radiologists to describe lumbar spine X-rays.

Methods: 120 consecutive X-ray reports for patients referred by primary care physicians were anonymised. A formal summative content analysis was undertaken. The coded words were grouped into categories according to their perceived meaning, and the process was refined until there were only three mutually exclusive categories.

Results: Half the sample was aged 60 years or younger. Three categories were identified: anatomical, pathological and descriptive. In the pathological category, 33% of words described normal appearances, 47% described age-related changes and 20% described other features. In only 2% of cases were pathological words used to describe conditions as being "normal for age". Overall, 89 (74%) of the 120 reports contained at least one phrase containing words indicating the presence of degenerative changes.

Conclusions: Almost three-quarters of lumbar spine X-ray reports use pathological words such as 'degenerative changes' to describe age-related changes but rarely describe them as being "normal for age".

This piece of the submission is being sent via mail.

*** Title Page**

Content Analysis of General Practitioner Requested Lumbar Spine X-ray Reports

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Low back pain, radiography, family practice, x-ray report, content analysis

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Introduction

Non-specific low back pain is a common problem: over 50% of people will have experienced at least one attack by late middle age [1]. Most episodes are self limiting but can sometimes develop into long-term disability with enormous cost to the individual and society. Psychological factors such as illness beliefs, catastrophizing and fear-avoidance are important predictors of chronicity and disability [2,3].

Radiographic studies in urban communities in the 1950s found that "degenerative changes" were common and increased with age but did not correlate with back pain [4]. In a systematic review of 18 studies, Van Tulder et al suggested that degeneration, defined by the presence of narrowing disc space, osteophytes and sclerosis, was associated with back pain [5]. However, because of the high prevalence of degenerative changes and the small associated increased risk of back pain, the actual relationship is weak (see also Symmons et al [6]).

Conversely, a study examining the prevalence of lumbar disc degeneration and low back pain found lumbar disc degeneration manifested earlier in a greater number of participants with low back pain [7]. Therefore, the interpretation of degenerative changes seen on spinal X-rays in the context of a patient with back pain is an uncertain art and remains controversial.

National guidelines advise that routine lumbar spine X-rays are avoided for simple low back pain because they rarely pick up serious pathology and expose people to radiation [8,9]; yet patients with back pain want X-rays [10]. Most general practitioners (GPs) order X-rays to reassure their patients [11]. Patients who have spine X-rays are more satisfied with their treatment than patients who do not have X-rays but report more pain, lower overall health status and no difference in disability, and consult their doctor more frequently [12]. Could it be that the way in which X-ray reports are communicated has an effect on the outcome of an episode of back pain? As Waddell states, "Think about the things we tell patients with ordinary backache.

Take the example of normal, age related changes on lumbar spine x-rays: 'You have wear and tear in your spine' or even worse, 'degenerative disc disease'. To patients, this means serious deterioration; it is irreversible, and will get even worse as they get older. If I'm like this now what will I be like in 10 years? Will I end up in a wheelchair? It is no use saying: 'But it is nothing to worry about!' The damage has been done. We have labelled them with a disease that will make them ill." [13]. We found little in the literature to support or refute the contention that X-ray reports may harm patients and wish to explore this further. As a start we carried out a content analysis of lumbar spine X-ray reports to determine the words used by radiologists to describe radiographic appearances and the frequency of their use.

Methods

Having gained Ethics and Research Governance Committee approval and the written informed consent of all relevant radiologists at a district general hospital in the south of England, consecutive reports for GP-requested lumbar spine X-rays were obtained from the senior radiology secretary over a four-week period. It was anticipated that this would generate sufficient reports to undertake a content analysis. Each report was photocopied and all patient and radiology identifiers removed – the age of the patient was added to the form at this stage.

A formal summative content analysis was undertaken to determine not only the frequency of words [14] but also the contextual meaning [15]. The reports and patients' ages were typed up using Microsoft Word and a word count of each report was undertaken. Each report was then split into individual phrases and these phrases were entered into one column of a spreadsheet (SPSS, version 13) and numbered. Each word appearing in the phrases was given an exclusive code number which was entered into the next column. Link words such as "and", "the" and "was" were excluded. The coded words were grouped into categories according to their perceived meaning and the process was refined until there were only three exclusive

categories labelled in separate columns. For one category, an additional code of "present" or "not present" was added in a separate column and the code words divided into three subcategories.

Two clinicians (a radiologist and a rheumatologist), blinded to the numerical codes, independently classified all the coding words into the three categories to assess inter-rater variation.

The spreadsheet enabled us to calculate how frequently different words were used. These results are presented graphically for words occurring five or more times and in a box for words occurring less than five times. Ages in different codes were compared using t-tests and inter-rater variation was assessed using Cronbach's alpha (SPSS, version 13).

Results

In total, 120 consecutive GP-requested lumbar spine X-ray reports, dictated by 12 consultant radiologists, were collected and anonymised. The patients' mean (SD) age was 59 (18) years with a range of 16 to 95 years. The age frequency distribution is shown in Figure 1. Over half the sample was aged 60 years or younger.

The mean (SD) number of words in each report was 45 (25); 676 separate phrases were identified with a range from one to seven for individual reports; 145 code words were identified and grouped into three categories: "anatomical" words (n=45), "pathological" words (n=55) and "descriptive" words (n=45). Eighty-six percent of reports contained "anatomical" category words, 98% contained "pathological" category words and 14% contained "descriptive" category words. Inter-rater agreement was good (Chronbach's alpha 0.85).

Figure 2 shows the frequency of each code word for the 495 words in the "anatomical" category. Words relating to the intervertebral disc were most commonly used.

Figure 3 shows the frequency of each code word for the 655 words in the "pathological" category (present = 594, not present = 59). The code words have been further classified into three subcategories: (a) "normal appearances" (n=181), (b) "degenerative changes" (n=269 present, n=14 absent), and (c) "other features" (n=146 present, n=45 absent). Overall, 74% (n=89) of the 120 reports included at least one phrase containing code words in the "degenerative changes" sub-category.

The words in the "normal appearances" subcategory related to "anatomical" category words in most cases, e.g. "normal vertebral height" and "disc spaces maintained". In only 2% of cases were changes described as being "normal for age". Only a small number of words indicated the possibility of serious pathology, e.g. "fracture", "lesion" and "anomaly", although this was usually mentioned for its absence, as in "no anomaly seen". The frequency of words in the "normal appearances" subcategory fell from 68% in the 21–30 age group to 17% in the over 80s, while the frequency of words in the "degenerative changes" subcategory rose from 4% in the 21–30 age group to 49% in the over 60s.

Figure 4 shows the frequency of each code word for the 205 words in the "descriptive" category. These words mainly related to the degree of "pathological" category changes, e.g. "mild degenerative arthritis". In most cases, severity was described with words meaning mild or moderate.

Discussion

This was a study of normal practice during one month in a busy district general hospital. We were surprised at the number of GP requests for X-rays for patients with low back pain (over 30 per week) from a catchment population of about 200,000 although theey were similar to those reported at the neighbouring Royal Bournemouth Hospital. We were unable to assess how many of the referrals fulfilled national guidelines with respect to red flags [8,16] but it would appear that there is considerable pressure on GPs to order X-rays. Indeed, a recent Norwegian study

assessing the myths and perceptions of back pain in a sample of the general population (n=1,014) confirmed that the use of X-rays to identify the cause of pain and the necessity to have a spine X-ray are deeply entrenched beliefs [17].

Post-mortem studies have demonstrated morphological changes in lumbar spine segments. The discs appear hardened, cracked and narrowed, bony spurs (osteophytes) form around the disc margins and bone is laid down under endplates (sclerosis). The facet joint cartilage fragments and osteophytes form, giving a hypertrophied appearance. These changes are more common in men and are found more frequently in the lower lumbar segments [18]. They can be detected on lumbar spine X-rays and MRI scans and are frequently summarized as “degenerative changes”. The X-ray appearances correlate with the changes seen at autopsy [19] and their prevalence increases with age; in one study, rising from 20% in under 35-year-olds to 71% in 65-74-year-olds [20]. While the frequency of degenerative changes was lower in younger people, this age group’s interpretation of the words “degenerative” and “spondylosis” may have greater impact compared with that of people in their 70s. In our study, a significant number of patients were young: 20 patients were under 40 years of age and just over half of the sample was aged 60 or younger although this age range is similar to other studies [20]. Perhaps, “common for age”, would be a more useful description as “age related” changes are by definition uncommon (and therefore potentially abnormal) in young individuals.

It is already known that the influence of psychological factors appears increasingly important in the transition from acute to chronic low back pain [21, 22]. Indeed, the potential role of “catastrophizing” has received considerable interest. The contemporary view is that catastrophizing involves rumination, magnification and helplessness [2]. It has emerged as one of the most robust predictors of the pain experience [23] and has been observed in chronic pain patients [24]. At this point we can only speculate on the role that catastrophizing may play for patients receiving

their X-ray report findings. We could find no studies that explore how the findings from X-ray reports are explained to the patient and this warrants further exploration.

To our knowledge, our study is the first formal content analysis of lumbar spine X-ray reports, although other studies have shown a similarly high prevalence of degenerative changes that correlate positively with age, and normal findings that correlate negatively with age [19]. There were, however, several limitations including ethical review, sample size and validity and generalisability.

Due to Ethics Committee constraints, we were requested to remove all patient information (except age) and the radiologists' identities. We were also unable to collect patient demographic or clinical data. Constraints and variation in ethical review and the negative impact this may have on research has been the subject of much debate [25]. The impact of these decisions may have resulted in unequal contributions to the sample of reports by individual radiologists, although we know that all 12 were reporting during the study period. While we cannot rule out a sex bias or patient selecting on clinical grounds, for example the use of red flags, Van den Bosch et al [20] found similar frequency of degenerative changes in men and women.

Determining an adequate sample size for content analysis was achieved by reviewing similar studies. We found wide variation in sample size: from 81 e-mail communications between a primary care provider and patients [26] to 921 newspaper articles to understand how print coverage may affect primary and secondary skin cancer prevention in the United States of America [27]. The traditional inference that an increased sample size improves validity and reliability is not directly transferable to the analysis of qualitative data. Our results for frequency of findings and relationship to age are similar to other studies, which supports the adequacy of the sample.

In qualitative research, the term validity is replaced by credibility which deals with the focus of the research and how confidently data and data processes address the intended focus of the study. Concerns regarding the generalisability of the results

or findings are replaced with transferability. Transferability refers to the extent to which the results can be generalised or transferred to other contexts or settings and is primarily the responsibility of the one doing the generalising. We believe this study demonstrates this in that the findings echo those of our peers [13] and published literature [20]. Qualitative researchers can enhance transferability by thoroughly describing the research context and the assumptions that were central to the research study, and by ensuring that they are clearly articulated in the paper [28].

Conclusion

This study showed that three quarters of lumbar spine X-ray reports included at least one phrase containing words indicating the presence of “degenerative changes”. It was rare for the radiologists to comment that the changes were “normal for age”. While we cannot make assumptions about how emotive the use of these words might be in the context of an episode of back pain, the study indicates that there is the possibility for patients to misinterpret their report as described by Waddell [13]. Recognising this, Roland and Van Tulder [29] proposed that radiologists should use epidemiological information to help interpret their findings, with a view to reducing the potential for misinterpretation of their reports. None of the reports we analysed contained this type of information. Further studies are needed to determine how GPs interpret the results, how they explain the results to patients, how patients interpret them, what actions the patients take, and most importantly, the effect these have on the persistence and severity of pain and disability.

Acknowledgments

We thank Tracey Wellstead for preparing the X-ray reports and Professor Alan Breen for his helpful and constructive comments on the manuscript.

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Figure Legends

Figure 1. Frequency distribution of age for 120 patients.

Figure 2. Frequency of words in the anatomical category in 120 reports of GP requested lumbar spine radiographs occurring 5 times or more shown in the graph and less than five times in the box.

Figure 3. Frequency of words in the pathological category either present or not present in 120 GP requested lumbar spine X-ray reports occurring 5 times or more shown in the graph and less than five times in the box.

Figure 4. Frequency of words in the descriptive category in 120 reports of GP requested lumbar spine radiographs occurring 5 times or more shown in the graph and less than five times in the box.

Figure 1

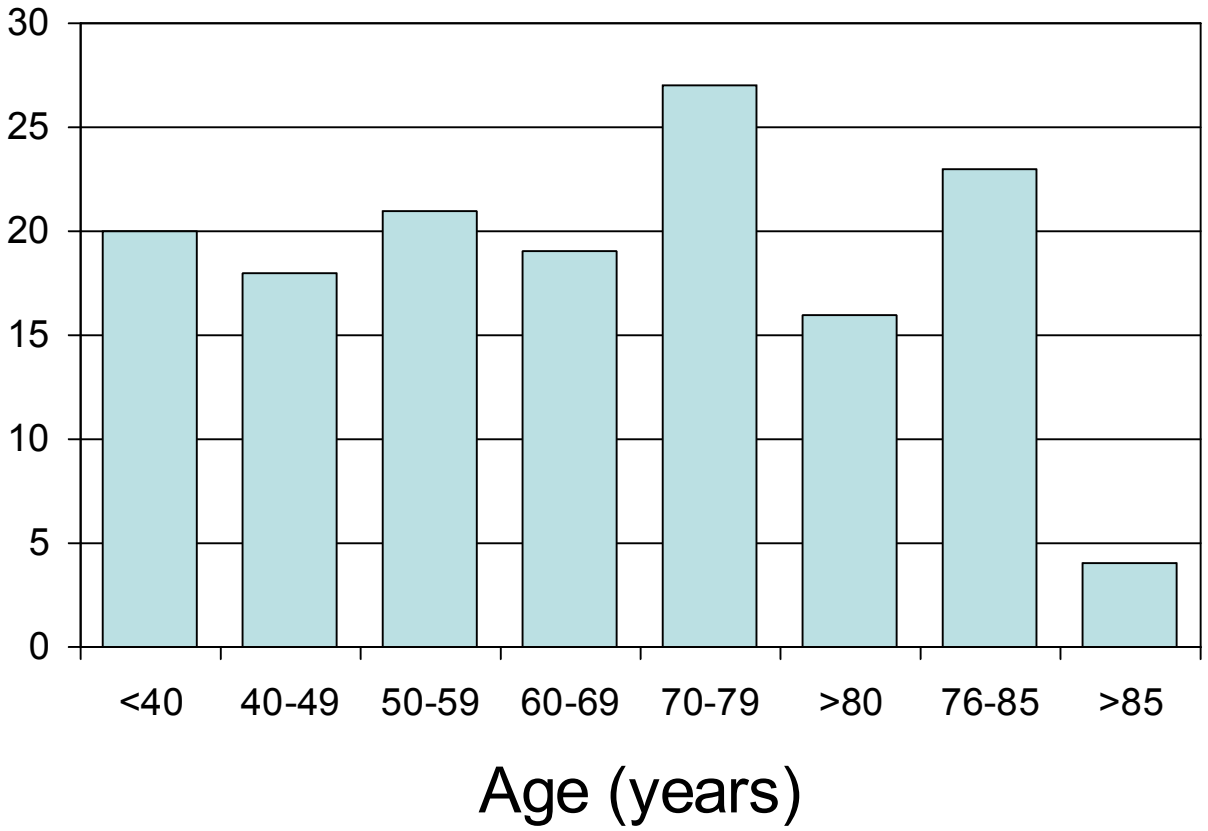
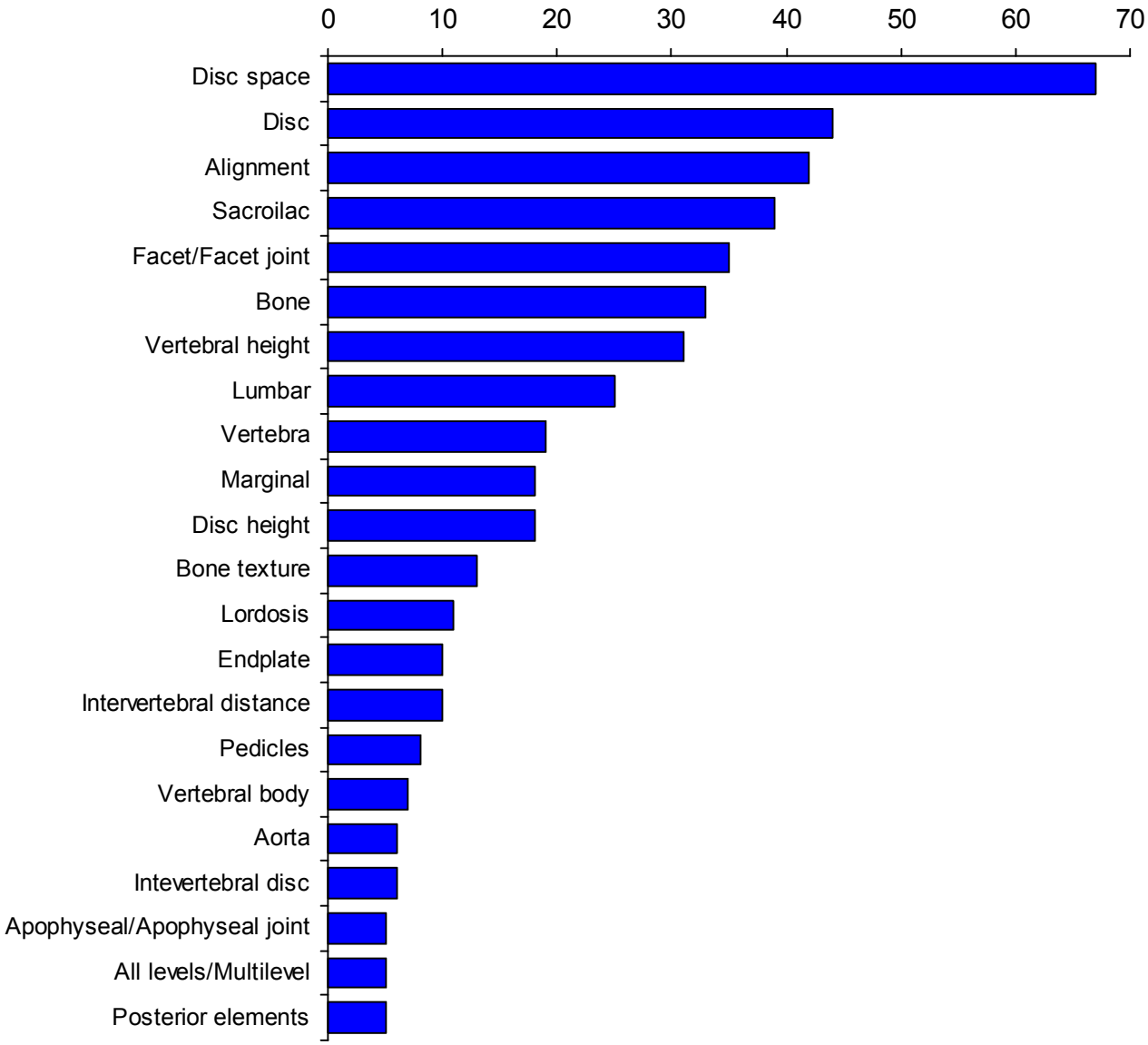
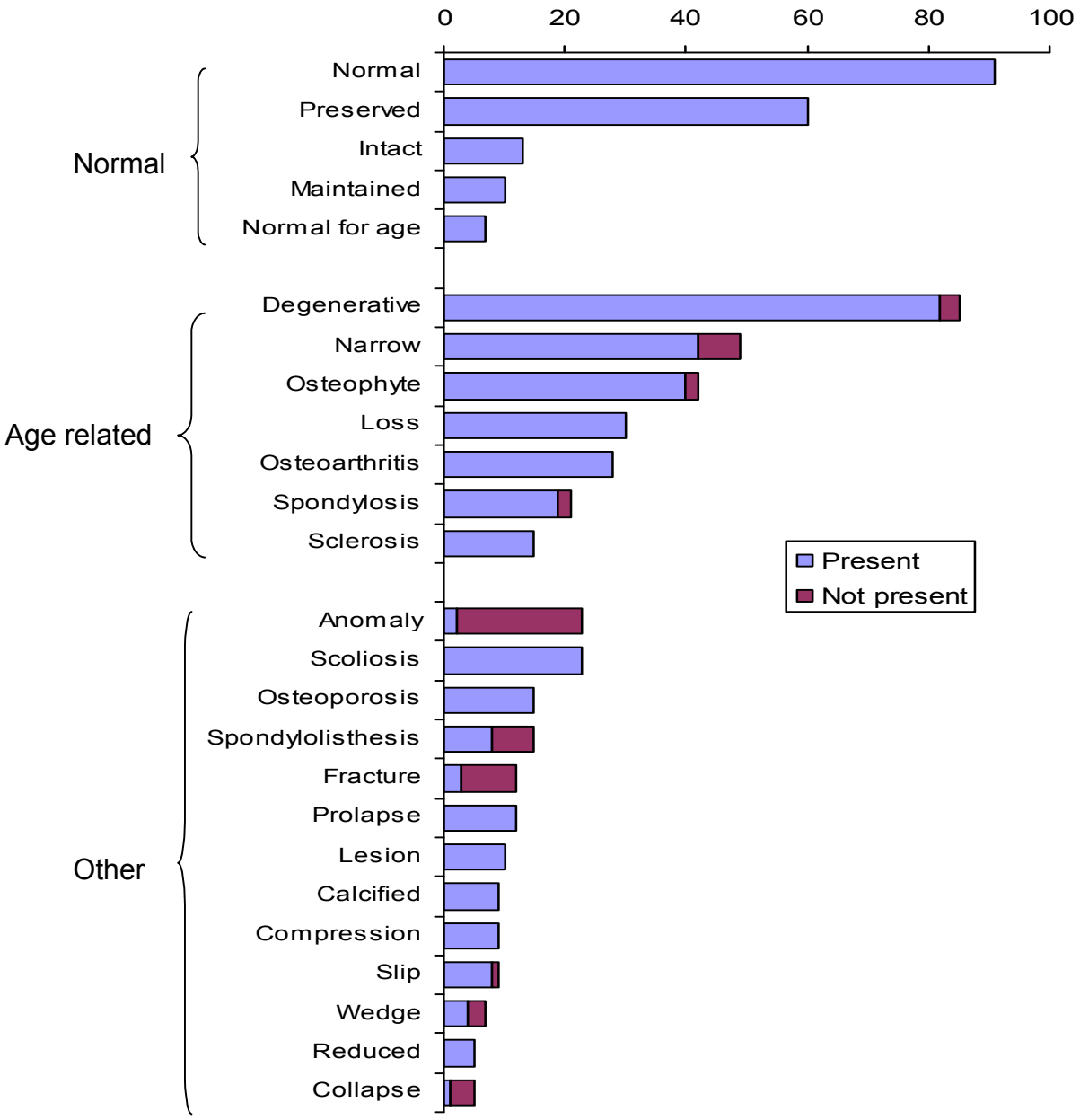


Figure 2



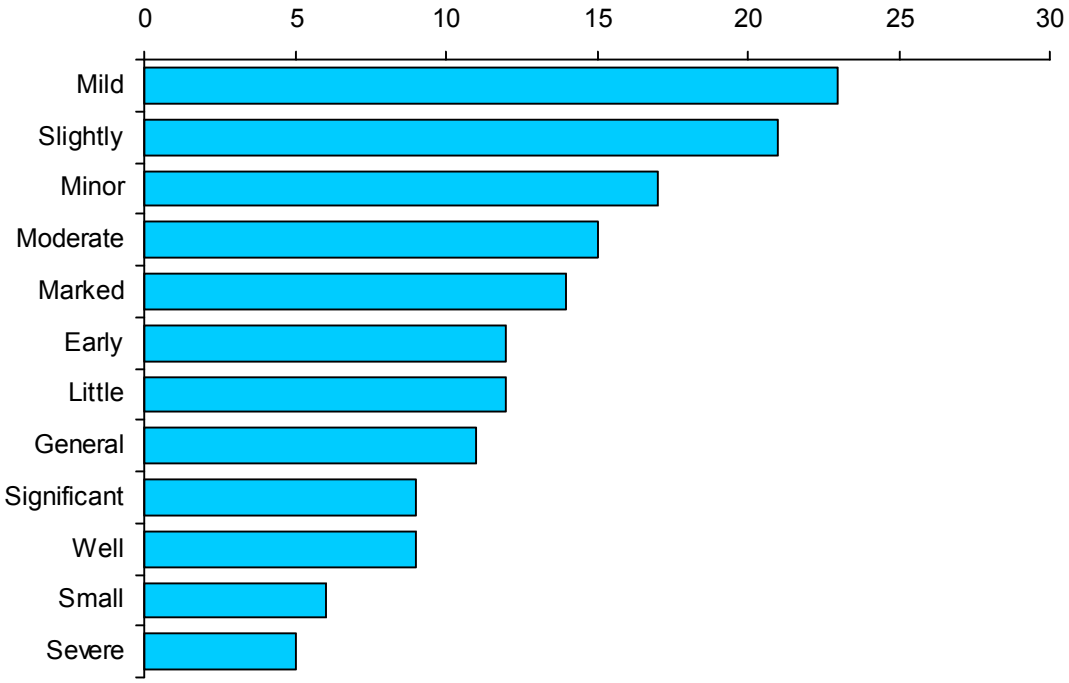
Frequency	Words
Four times	biconcave, body
Three times	Anterior, pars interarticularis, spine, spinous process
Twice	bone mineral, ligament
Once	central, periarticular, sacral, segmentation, lumbosacral.

Figure 3



Frequency	Words
Four times	-
Three times	lipping, lumbarisation, spurs, stenosis, transitional
Twice	deposit, rudimentary rib, injury, suspicious features, defect
Once	aneurysm, disease, ossification, demineralization, dislocation, gas, tilt, accessory vertebra, fused, obliterated, vacuolation, hypertrophy, sacralisation, pseudoarthrosis, Schmorl's nodes, spina bifida, curved

Figure 4



Frequency	Words
Four times	minimal, very early
Three times	advanced, large, partial, quite marked
Twice	essential, virtual, particular, focal, incidental, tiny
Once	A lot, bulky, burst, heavy, poor, progression, relatively well, satisfactory, very poorly, very sligt, very mild, very minor, acute, chronic, congenital, scattered, modest, prominent

Itemised List of Revisions

Reviewer

1. Discussion expanded to include this point. Page 6 Para 2.

2. We do not feel we have sufficient data at this point to enter into a discussion of the relative merits of reporting different phrases but will hope to address these issues in future work. The point is touched on in the Discussion (Page 6 para 3) but we feel is beyond the scope of this paper, as is a discussion of the pros and cons of Radiographer reporting.

3. Due to Ethics Committee restrictions we were unable to identify the individual reporter so have not been able to explore their reasons for using the descriptors. The term calcified was usually coupled with aorta reporting calcification of the aorta rather than calcified disc.