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Fine needle aspiration for the diagnosis and treatment of musculoskleletal tumours



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A R T I C L E I N F O

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ABSTRACT

Objective: The aim of this study was to evaluate the diagnostic accuracy of FNA and analyse its efficacy in enabling the initiation of treatment in musculoskeletal tumours.

Methods: A total of 130 FNA were performed (94 bone and 36 soft tissue lesions) guided by CT scan (n = 64), ultrasonography (n = 36) and radioscopy (n = 30). Diagnostic yield and accuracy were evaluated. A diagnosis was considered accurate when confirmed by histology or ulterior clinical/imaging evaluation. Exclusion of malignancy or infection was considered as diagnoses.

Results: Ninety diagnoses (69.2%) were obtained: 87 (96.7%) were accurate and 3 were wrong. FNA was non-diagnostic in 40 cases (30.8%) but in 15 (11.5%) it has been possible to conclude if the lesion was malignant (n = 6) or benign (n = 9). This method was completely inconclusive in 25 cases (19.2%).

Conclusion: Despite the low diagnostic yield, accuracy was high. FNA allowed the initiation of treatment in all 87 patients with a correct diagnosis and in 9 in which malignancy was excluded. Two of the 6 biopsies with the information of malignancy were soft tissue lesions. Even here, treatment could be done, as the majority of soft tissue sarcoma protocols begin with surgery. This study validates FNA as a method with a high diagnostic accuracy.

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Introduction

Fine needle aspiration (FNA) is a well-established tool for the diagnosis of palpable and non-palpable lesions such as those localised to lymph nodes, salivary glands, breast, liver and pancreas, among others. Less enthusiasm is felt for the usage of this technique in the investigation of bone and soft tissue tumours; this is primarily due to their rarity and to difficulties in studying their morphology and obtaining their diagnoses.¹

Even in specialized centres, where pathologists integrate all the clinical and image information, FNA has not reached the value of trucut biopsy, which is considered the main alternative to incisional biopsy.¹² Several factors are in the basis of the existing scepticism such as the small volume of sample collected, the fact that it only

characterizes the sample cytologically, the overlapping of the cytomorphology of various tumours and the large variability of results published in studies over the years.²

However, given that it is a less invasive procedure, performed in an outpatient basis without general anaesthesia or hospitalization, as well as having a much lower cost, FNA is an attractive technique when compared to more invasive options. FNA has also the advantage of enabling the aspiration of different parts of a same tumour, which is particularly important in large and heterogeneous neoplasms.

The purpose of this study was to evaluate the diagnostic accuracy of fine-needle biopsy, and to analyse to which extent this method enables the initiation of treatment, clarifying its role in addressing musculoskeletal tumours.

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Materials and methods

One hundred and thirty patients submitted to FNA-derived cell block over a 3-year period were retrospectively reviewed. In the majority of these cases a diagnosis of bone or soft tissue tumour was necessary to start treatment but in a few the exclusion of malignancy was also important. All procedures were performed by one single team (one orthopaedic surgeon and one radiologist) and samples were analysed by the same pathologist.

The average age of the patients was 53.2 years (12–90). There were 59 males and 71 females. Ninety-four underwent bone and 36 soft tissue biopsies. All FNA were performed under image guidance (Fig. 1). Table 1 depicts the clinical characteristics of the tumours, their anatomical location and the imagiological method used to localize them.

The most suitable route was chosen in order to avoid noble structures such as neurovascular bundles and organs. After the selection of the area, skin was anesthetized with 3–5 ml of 2% Lidocaine and cytoaspiration with a 22-gauge needle was performed. Samples were placed in CytoRich[®] Red Preservative Fluid and sent to laboratory. The pathologist did not do any preliminary evaluation during the procedure. All samples were centrifuged at 1500 rpm for 10 min, after which the supernatant was discarded. Haematoxylin and Histolgel[®] were then added and the sample was vortexed for homogenisation. Homogenised sample was then frozen. Frozen tissue was placed in biopsy cassettes and used for histology (Haematoxylin and Eosin) and immunohistochemistry (Fig. 2).

The diagnostic yield (ratio between the number of diagnosis achieved and the number of all procedures) and accuracy (ratio between the confirmed diagnosis and the number of established diagnosis) were evaluated. A diagnosis was considered to be accurate when it was confirmed by histology—trucut biopsy, incisional biopsy, surgery—or ulterior clinical and imaging evaluation as some benign tumours, metastases and hematopoietic lesions do not need histological confirmation. Diagnostic yield and accuracy of soft tissue and bone lesions were analysed and compared. Statistical analysis was performed using GraphPad Prism v. 6.0. The differences between means were compared using *t*-test. A p value < 0.05 was considered to represent a statistically significant difference.

The minimum follow up was 2 years. Exclusion of malignancy or infection, when clinically suspected, was included in the group of diagnosis.

Results

In 90 patients (69.2%) a diagnosis was obtained and in 87 (96.7%) were accurate. In 36 cases accuracy was confirmed by histology and in 54 cases by clinical and imaging valuation.

In the group of osseous lesions diagnoses were: 28 metastases, 17 primitive malignant tumours, 7 benign tumours, 10 hematologic diseases and 2 infections; in 7 cases pathology could be excluded. In this group only 2 benign lesions were misdiagnosed: a spondylodiscitis of a dorsal vertebra was diagnosed as a Giant Cell Tumour and a low-grade chondrosarcoma of the scapula was assumed as an enchondroma (Table 2).

In the group of soft tissue tumours 10 lesions were found to be benign, 6 malignant and 3 were classified as hematologic diseases.



Fig. 1. Examples of the imagiological methods used for tumour localisation: A) Ultrasonographic view of a soft tissue lesion in the thigh, B) Identification of a bone lesion in the sacrum using CT, C) Identification of a bone lesion in the humerus using X-ray.

Table 1

Clinical characteristics of bone and soft tissue lesions diagnosed by FNA.

Total	Туре	Gender	Mean age (range)	Anatomical location	Image guidance
130 biopsies	Bone 94 Soft tissue 36	Male 59 Female 71	53.2 (12–90)	Lower limb 45 Upper limb 22 Spine 27 Pelvis 24 Trunk 12	CT-scan 64 Ultrasonography 36 Radioscopy 30



Fig. 2. Chordoma of sacrum. A (HE 100×). B (HE 400×). Although "phisaliphorous cells" are not present, epithelioid cells are characteristically arranged as cords and embedded in an extracellular myxoid matrix.

In this group an extra abdominal desmoid tumour of the dorsal paravertebral region was wrongly diagnosed as a liposarcoma (Table 2).

The overall diagnostic yield was 69.2% and the diagnostic accuracy 96.7%. The diagnostic yield for bone lesions alone was 75.5% and that for soft tissue lesions was 52.8% (p = 0.0187). The diagnostic accuracy for bone lesions alone was 97.2% and that for soft tissue lesions was 94.7% (p = 0.5704) – Table 3.

FNA was non-diagnostic in 40 cases (30.8%) but in 15 biopsies (11.5%) it was possible to conclude if the lesion was malignant (n = 6) or benign (n = 9) and this information was correct in all cases. It was then considered a completely inconclusive result in 25 cases (19.2%). There were no complications associated with these procedures and all patients were discharged on the same day of the procedure.

Discussion

All cytological results should always be interpreted integrating the clinical and imaging context, which influence the diagnosis regardless of the diagnostic modality chosen. The value of FNA also depends on the operator technique³ and on the experience of the pathologist.⁴

The first challenge that the FNA faces is obtaining an appropriate sample - checking whether the sample is sufficient in quantity and representative enough to allow for the diagnosis. This point is measured by yield, and values can vary between 3 and 31% of inadequate samples.^{2,5} There are several reasons that help to explain the wide variation of rates, including the type of lesion studied and the accomplishment of preliminary evaluation. The preliminary evaluation comes from the observation of the sample by the pathologist during the procedure, allowing its repetition if necessary, with substantially improved results when compared to studies where this evaluation is not performed.^{5,6} In this study, the quantity and quality of the sample was decided by the executant alone without the presence of the pathologist. Perhaps this was the reason for the poor overall diagnostic yield (69.2%). There are two reasons for a non-diagnostic result. The first is a scant, acellular or

artifactually distorted specimen. The second is when the result is incompatible with the clinical and/or image impression.^{5,6} All the 25 completely inconclusive results were due to technical issues with samples. The yield, however, was significantly higher for bone tumours than for soft tissue lesions (p = 0.0187). Again, this difference may be explained by the same two reasons: analysis of tissue architecture and morphology are more important in identifying and distinguishing between soft tissue lesion subtypes and the fact the clinical and imaging information are more informative in the case of bone than in soft tissue lesions.⁷

The accuracy of a diagnostic technique is the most important parameter in its assessment, and obtaining an exact result is its main objective. In different studies, the diagnostic accuracy of FNA varies between 75% and 98%, where the lowest values are obtained in smaller samples.^{3,8,9} If it were only considered studies with high samples (n > 300) this value would be greater than 95%.^{2,6,10–12} Here, the accuracy was 96,7%, which is even superior to that reported in other studies^{3,9,11,13} showing the reliability in the diagnosis of benign tumours, sarcomas, metastases, infections, hematologic disease lesions and in excluding pathology. No significant differences in accuracy were found between soft tissue and bone lesions (p = 0.05704).

In many cases of musculoskeletal tumours, the specific diagnosis has a minor role in the initiation of treatment. The histological grade, staging and anatomical location are the most important factors for therapeutic decisions and it may even be said that the existing protocols are less based on the histological subtype. Some authors go further, referring to the minor importance of histological subtype and highlighting the relevance of the distinction between sarcoma and metastasis, since the treatment of most sarcomas in adults is primarily based on its size, location and proximity to vital structures.¹⁴ Kilpatrick et al¹⁵ considered FNA sufficient to initiate treatment in 83% of soft tissue tumours and in 87% of bone tumours. In a study conducted in 2010, definitive treatment could be initiated based solely on FNA in 81.3% of benign, in 78% of malignant and in 43% of the indeterminate tumours.¹² Assuming the same criteria, the technique in the present study would therefore allow for the initiation of treatment in all 87 patients with a diagnosis

P. Cardoso et al. / Acta Orthopaedica et Traumatologica Turcica 51 (2017) 278-283

 Table 2

 Correlation between cytological and final diagnosis in bone and soft tissue tumours.

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25BoreInconclusiveOrechondroma26Soft tissueInconclusiveSynold accoma27Soft tissueInconclusiveChordrosarcoma28BoneInconclusiveChordrosarcoma29Soft tissueInconclusiveMyositi Sosificars30Soft tissueInconclusiveMyositi Sosificars31Soft tissueInconclusiveHemangiona32Soft tissueInconclusiveHemangiona33BoneChordrosarcomaKwig Sortoma34Soft tissueKwig SortomaKwig Sortoma35BoneInconclusiveHemangioma36BoneChordrosarcomaKwig Sortoma37BoneChordrosarcomaMyolama38BoneChordrosarcomaChordrosarcoma39Soft tissueChordrosarcomaChordrosarcoma30Soft tissueChordrosarcomaChordrosarcoma31BoneChordrosarcomaChordrosarcoma32Soft tissueChordrosarcomaChordrosarcoma34BoneChordrosarcomaChordrosarcoma35Soft tissueChordrosarcomaChordrosarcoma36Soft tissueChordrosarcomaChordrosarcoma37BoneMeditatisMeditatis38BoneChordrosarcomaChordrosarcoma39Soft tissueChordrosarcomaChordrosarcoma39BoneChordrosarcomaChordrosarcoma39Bon	24	Bone	Inconclusive	Chondrosarcoma
26Soft tissueInconclusiveMyelona27BoneInconclusiveMyelona28BoneInconclusiveCondrosarcoma29Soft tissueImponaMyelona30Soft tissueImponaMyelona31Soft tissueBenja lesionHaemangioma32Soft TissueBenja lesionHaemangioma33BoneChordrosarcomaChordrosarcoma34Soft tissueInconclusiveHaemangioma35BoneInconclusiveHaemangioma36Soft tissueInconclusiveMyelona37BoneMyelonaMyelona38BoneChordrosarcomaMyelona39BoneChordrosarcomaMyelona39BoneChordrosarcomaMyelona30BoneChordromaMyelona31BoneMyelonaMyelona32BoneChordromaMyelona34BoneChordromaMyelona34BoneMyelonaMyelona34BoneMyelonaMyelona34BoneMyelonaMyelona34BoneMyelonaMyelona34BoneMyelonaMyelona34BoneMyelonaMyelona34BoneMyelonaMyelona34BoneMyelonaMyelona35BoneMyelonaMyelona36BoneMyelonaMyelona <t< td=""><td>25</td><td>Bone</td><td>Inconclusive</td><td>Osteochondroma</td></t<>	25	Bone	Inconclusive	Osteochondroma
27Soft iissueMyelonaMyelona28BoneInconclusiveCondrosarcoma29Soft iissueInconclusiveMyesiti softicans30Soft iissueInconclusiveMyesiti softicans31Soft iissueInconclusiveHaemangioma32BoneInconclusiveHaemangioma33BoneInconclusiveHaemangioma34BoneInconclusiveMyesiti softicans35BoneInconclusiveMyesiti softicans36BoneInconclusiveMyesiti softicans37BoneCondrosarcomaCondrosarcoma38BoneCondrosarcomaCondrosarcoma39Soft iissueGonglion cystMyelona30Soft iissueCondrosarcomaMyelona31BoneCondrosarcomaMyelona32Soft iissueCondrosarcomaMyelona34BoneCondrosarcomaMyelona35BoneMyelonaMyelona36BoneMyelonaMyelona37BoneMyelonaMyelona38BoneMyelonaMyelona39BoneMyelonaMyelona39BoneMyelonaMyelona30BoneMyelonaMyelona31BoneMyelonaMyelona31BoneMyelonaMyelona32BoneMyelonaMyelona33BoneMyelonaMyelona<	26	Soft tissue	Inconclusive	Synovial sarcoma
28BoneInconclusiveChandrosarcoma29Soft rissueInconclusiveMyositis ossificans30Soft rissueBiga lesionHarmarigioma31BoneInconclusiveHarmarigioma32Soft rissueInconclusiveChandrosarcoma34BoneChandrosarcomaWing sarcoma35BoneInconclusiveHarmarigioma36Soft rissueInconclusiveMyosma37BoneMyolomaMyosma38BoneChandrosarcomaMyosma39Soft rissueCanglion cystCanglion cyst39BoneChandrosarcomaChandrosarcoma30BoneChandrosarcomaMyoloma31BoneChandrosarcomaChandrosarcoma31BoneChandrosarcomaChandrosarcoma32BoneChandrosarcomaMyoloma34BoneChandrosarcomaChandrosarcoma35BoneChandrosarcomaChandrosarcoma36BoneChandrosarcomaChandrosarcoma37BoneMetastasisMetastasis38BoneChandrosarcomaChandrosarcoma39BoneMetastasisMetastasis30BoneChandrosarcomaChandrosarcoma31BoneMetastasisMetastasis32BoneGant Cell TunourChandrosarcoma34BoneGant Cell TunourChandrosarcoma35BoneMe	27	Soft tissue	Myeloma	Myeloma
29Soft issueJymphomaJymphoma30Soft issueInconclusiveMymissi sosificans31Soft issueBenign lesionHaemangioma32Soft issueChondrosarcomaChondrosarcoma33BoneChondrosarcomaEving sarcoma34Soft issueEving sarcomaEving sarcoma35BoneInconclusiveMysoma36Soft issueInconclusiveMysoma37BoneChondrosarcomaChondrosarcoma38BoneChondrosarcomaChondrosarcoma39Soft issueCanglion cystGanglion cyst40BoneChondrosarcomaEving Sarcoma41BoneChondrosarcomaEving Sarcoma42BoneChondrosarcomaEving Sarcoma43BoneChondrosarcomaEving Sarcoma44BoneMetastasisMetastasis45BoneChondromaChordroma46BoneChondromaChordroma47BoneBoneChondromaChordrosarcoma48BoneChandromaChordrosarcoma49BoneChandromaMetastasis41BoneChandromaMetastasis42BoneChandromaMetastasis43BoneChandromaMetastasis44BoneChandromaMetastasis45BoneChandromaMetastasis46BoneChandromaMetastasis <td>28</td> <td>Bone</td> <td>Inconclusive</td> <td>Chondrosarcoma</td>	28	Bone	Inconclusive	Chondrosarcoma
30Soft issueInconclusiveMyositis ossifions/31Soft issueBing lesionHaemangioma32Soft TissueInconclusiveChandrosarcoma34Soft issueEwing sarcomaEwing sarcoma35BoneInconclusiveHaemangioma36Soft itsueInconclusiveHaemangioma37BoneMyoomaMyooma38BoneChordrosarcomaChordrosarcoma39Soft itsueGaglion cystGaglion cyst39BoneChordrosarcomaChordrosarcoma39BoneChordrosarcomaChordrosarcoma30BoneChordrosarcomaChordrosarcoma30BoneChordrosarcomaChordrosarcoma40BoneChordromaChordrosarcoma41BoneChordromaMetatasis42BoneMetatasisMetatasis43BoneMetatasisMetatasis44BoneChordromaMetoma45BoneMetatasisMetatasis46BoneChordromaMetoma47BoneMetatasisMetatasis48BoneChordromaMetatasis49BoneChordromaMetatasis41BoneMetatasisMetatasis42BoneChordromaMetatasis43BoneChordromaMetatasis44BoneChordromaMetatasis45BoneMetatasis	29	Soft tissue	Lymphoma	Lynphoma
11Soft issueBeingin lesionHatemangiona12Soft TissueInconclusiveHatemangiona13BoneChondrosarcomaChondrosarcoma14Soft tissueInconclusiveHatemangiona15BoneInconclusiveMyeloma16Soft tissueInconclusiveMyeloma17BoneMyelomaChondrosarcoma18BoneChondrosarcomaMyeloma19Soft tissueGangion cystGangion cyst10BoneChordomaChordoma11BoneChordomaMyeloma12BoneChordomaChordoma13BoneChordomaChordoma14BoneChordomaChordoma14BoneChordomaChordoma14BoneChordomaChordoma15BoneMetatasisMetatasis16BoneChordomaChordoma17BoneMetatasisMetatasis18BoneChordomaChordoma19BoneChordomaChordoma10BoneChordomaMyeloma11BoneChordomaChordoma12BoneChordomaChordoma13BoneChordomaChordoma14BoneChordomaChordoma15BoneChordomaChordoma16BoneChordomaChordoma17BoneChordomaChordoma </td <td>30</td> <td>Soft tissue</td> <td>Inconclusive</td> <td>Myositis ossificans</td>	30	Soft tissue	Inconclusive	Myositis ossificans
32 600 Insure Introductory International 33 Bone Chardrosarcoma Eving sarcoma 34 Soft tissue Eving sarcoma Eving sarcoma 35 Bone Inconclusive Memangiona 36 Soft tissue Inconclusive Mysoma 37 Bone Mysoma Mysoma 38 Bone Chondrosarcoma Chondrosarcoma 39 Soft tissue Chondrosarcoma Chondrosarcoma 40 Bone Chondrosarcoma Chondrosarcoma 41 Bone Inconclusive Myeloma 42 Bone Metastasis Metastasis 44 Bone Metastasis Metastasis 45 Bone Chordoma Chordora 46 Bone Chordoma Chordora 47 Bone Bone Chordoma 48 Bone Chordoma Chordoma 49 Bone Erchondroma Chordoma	31	Soft tissue	Benign lesion	Haemangioma
34DoreChronicosationalChronicosational34Sofit fissueInconclusiveHaemangioma35BoneInconclusiveHaemangioma36Sofit fissueChordforsarcomaMyeloma37BoneChordforsarcomaChordforsarcoma38BoneChordforsarcomaChordforsarcoma39Sofit fissueGanglion cystGanglion cyst40BoneChordforsarcomaChordforsarcoma41BoneChordforsarcomaChordforsarcoma42BoneChordforsarcomaChordforsarcoma43BoneMetastasisMetastasis44BoneMetastasisMetastasis45BoneMetastasisMetastasis46BoneMetastasisMetastasis47BoneMetastasisMetastasis48BoneMetastasisMetastasis49BoneMetastasisMetastasis41BoneMetastasisMetastasis42BoneMetastasisMetastasis43BoneMetastasisMetastasis44BoneMetastasisMetastasis45BoneMetastasisMetastasis46BoneMetastasisMetastasis51BoneMetastasisMetastasis52BoneMetastasisMetastasis53BoneMetastasisMetastasis54BoneMetastasisMetastasis55Bo	32	Bono	Chondrosarcoma	Chondrosarcoma
aDoteIntroductionIntroduction3BoneIntroductionHarmangiona36Soft issueInconclusiveMycoma37BoneChondrosarcomaChondrosarcoma38BoneChondrosarcomaChondrosarcoma39Soft issueGanglion cystGanglion cyst40BoneInconclusiveMycloma41BoneChordomaChordoma42BoneEving SarcomaEving Sarcoma43BoneMetastasisMetastasis44BoneChordomaChordoma45BoneMetastasisMetastasis46BoneChordomaChordoma47BoneMetastasisMetastasis48BoneChordomaChordoma49BoneGant Cell TumourGant Cell Tumour49BoneMetastasisMetastasis49BoneMetastasisMetastasis51BoneMetastasisMetastasis52BoneMetastasisMetastasis53BoneMetastasisMetastasis54Soft itsueInconclusivoMetastasis55BoneMetastasisMetastasis56BoneMetastasisMetastasis57BoneMetastasisMetastasis58BoneMetastasisMetastasis59BoneMetastasisMetastasis51BoneMetastasisMetastasis	34	Soft tissue	Ewing sarcoma	Ewing sarcoma
96Soft issueInconclusiveMycoma97BoneMyclomaMycloma98BoneChondrosarcomaChondrosarcoma99Soft issueGanglion cystGanglion cyst40BoneChordomaChordoma41BoneChordomaChordoma42BoneChordomaChordoma43BoneMetastasisMetastasis44BoneMetastasisMetastasis45BoneMetastasisMetastasis46BoneMetastasisMetastasis47BoneMetastasisMetastasis48BoneChordomaChordoma49BoneChardomaMycloma41BoneMetastasisMetastasis42BoneChardomaMycloma43BoneMyclomaMycloma44BoneChardomaMycloma45BoneGant Cell TumourInfection46BoneMetastasisMetastasis57BoneMetastasisMetastasis58BoneMetastasisMetastasis59BoneBoneMetastasis51BoneMetastasis52BoneMetastasis53BoneMetastasis54BoneMetastasis55BoneMetastasis56BoneMetastasis57BoneMetastasis58BoneMetastasis5	35	Bone	Inconclusive	Haemangioma
97BoneMyelomaMyelomaMyeloma18BoneChondrosarcomaOhndrosarcoma39Soft tissueGanglion cystGanglion cyst40BoneInconclusiveMyeloma41BoneChordomaChordoma42BoneEving SarcomaMyeloma43BoneMetastasisMetastasis44BoneMetastasisMetastasis45BoneMetastasisMetastasis46BoneChordomaMyeloma47BoneChordomaMyeloma48BoneChordomaMyeloma49BoneChordomaMyeloma49BoneChordomaMyeloma49BoneInfectionGiant Cell Tumour50BoneInfectionGiant Cell Tumour51BoneInfectionGiant Cell Tumour52BoneInfectionMetastasis53BoneInfectionMetastasis54BoneInconclusivoAngeliopoma55BoneInconclusivoAngeliopoma56BoneInconclusivoAngerspinationis57BoneInconclusivoAngerspinationis58BoneInconclusivoAngerspinationis59Soft tissueInconclusivoAngerspinationis50BoneInconclusivoAngerspinationis51BoneMetastasisMetastasi52BoneMetastasisMe	36	Soft tissue	Inconclusive	Myxoma
38BoneChondrosarcomaChondrosarcoma39Soft tissueGanglion cystGanglion cyst40BoneInconclusiveMyeloma41BoneChordomaEving Sarcoma42BoneMetatasisMetatasis43BoneMetatasisMetatasis44BoneMetatasisMetatasis45BoneMetatasisMetatasis46BoneMetatasisMetatasis47BoneMetatasisMetatasis48BoneMetatasisMetatasis49BoneMetatasisMetatasis40BoneMetatasisMetatasis41BoneMetatasisMetatasis42BoneGant Cell TumourGiant Cell Tumour43BoneInfectionInfection44BoneMetatasisMetatasis55BoneMetatasisMetatasis54BoneNonclusivoMetatasis55Soft tissueInconclusivoAneurysmal bone Cyst56BoneSoft tissueIpoma61BoneIpomaMetatasis62BoneMetatasisMetatasis57Soft tissueIpomaAneurysmal bone Cyst63BoneIpomaMetatasis64BoneMetatasisMetatasis65BoneMetatasisMetatasis66BoneMetatasisMetatasis67BoneMeta	37	Bone	Myeloma	Myeloma
99Soft issueGanglion cystGanglion cyst40BoneInconclusiveMyeloma41BoneChordomaChordoma42BoneEving SarcomaEving Sarcoma43BoneMetastasisMetastasis44BoneMetastasisMetastasis45BoneMetastasisMetastasis46BoneMyelomaMyeloma47BoneMyelomaMyeloma48BoneGant Cell TumourGant Cell Tumour49BoneGant Cell TumourGant Cell Tumour50BoneMetastasisMetastasis51BoneMetastasisMetastasis52BoneMetastasisMetastasis53BoneMetastasisMetastasis54BoneMetastasisMetastasis55BoneMetastasisMetastasis56BoneMetastasisMetastasis57BoneBenign leionaAneurysmal bone cyst58BoneBenign leionaAneurysmal bone cyst59Soft tissueLipomaSignama61BoneMetastasisMetastasis62BoneBenign leionaAneurysmal bone cyst63BoneMetastasisMetastasis64BoneMetastasisMetastasis65BoneBoneMetastasis66BoneMetastasisMetastasis67BoneBoneMetastasis </td <td>38</td> <td>Bone</td> <td>Chondrosarcoma</td> <td>Chondrosarcoma</td>	38	Bone	Chondrosarcoma	Chondrosarcoma
40BoneIncordusiveMyeloma41BoneChordomaChordoma42BoneEwing SarcomaEwing Sarcoma43BoneMetastaisMetastais44BoneMetastaisMetastais45BoneMetastaisMetastais46BoneChordomaChordoma47BoneChordomaChordoma48BoneEnchonformaChordoma49BoneEnchonformaChordorsarcoma49BoneInfectionInfection50BoneMetastaisMetastais51BoneMetastaisMetastais52BoneMetastaisMetastais53BoneMetastaisMetastais54BoneMetastaisMetastais55BoneMetastaisMetastais56BoneBenign lesionAneurysmal bone Cyst57Soft tissueLipomaAperastais58BoneBenign lesionAneurysmal bone Cyst59Soft tissueLipomaLipoma61BoneMordorusSoft mortunour62BoneMetastaisMetastais63BoneBenign lesionAneurysmal bone Cyst64BoneMordorusiveSchwannoma65BoneMordorusiveSchwannoma66BoneAperaster ApproximationeMetastais67BoneBoneMordorusive68Bon	39	Soft tissue	Ganglion cyst	Ganglion cyst
41BoneChordomaChordoma42BoneEwing SarcomaEwing Sarcoma43BoneMetastasisMetastasis44BoneMetastasisMetastasis45BoneMetastasisMetastasis46BoneMetastasisMetastasis47BoneMetastasisMetastasis48BoneMetastasisChordoma49BoneMetastasisChondoraarcoma49BoneInfectionInfection50BoneMetastasisMetastasis51BoneMetastasisMetastasis52BoneMetastasisMetastasis53BoneInfectionAngiolipoma54Soft tissueInconclusivoAngiolipoma55BoneBenign lesionAtexatasis56BoneBenign lesionAneurysmal bone Cyst57Soft tissueLiposarcomaAgressive fibromatosis58BoneBenign lesionAneurysmal bone cyst59Soft tissueLiposarcomaAgressive fibromatosis61BoneBenign lesionAneurysmal bone cyst62Soft tissueLiposarcomaSeressive Comatosis63BoneAneurysmal bone cystMetastasis64BoneAneurysmal bone cystMetastasis65BoneAneurysmal bone cystMetastasis66BoneAneurysmal bone cystMetastasis67BoneAneurysma	40	Bone	Inconclusive	Myeloma
42 Bone Ewing Saroma Ewing Saroma 43 Bone Metastasis Metastasis 44 Bone Metastasis Metastasis 45 Bone Metastasis Metastasis 46 Bone Chordoma Chordoma 47 Bone Myeloma Myeloma 48 Bone Chordoma Chordoma 49 Bone Giant Cell Tumour Giant Cell Tumour 50 Bone Metastasis Metastasis 51 Bone Metastasis Metastasis 52 Bone Metastasis Metastasis 53 Bone Metastasis Metastasis 54 Soft tissue Inconclusivo Angeinpama 55 Bone Metastasis Metastasis 56 Bone Soft tissue Joparcoma Aggressive fibromatosis 57 Soft tissue Liposarcoma Aggressive fibromatosis 60 Bone Benign lesion Ane	41	Bone	Chordoma	Chordoma
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Pri BoneDoteMetastasisMetastasis45BoneChordomaChordoma46BoneChordomaMyeloma47BoneEnchondromaChondrosarcoma48BoneEnchondromaChondrosarcoma49BoneGiant Cell TumourGiant Cell Tumour50BoneInfectionInfection51BoneMetastasisMetastasis52BoneMetastasisMetastasis53BoneMetastasisMetastasis54Soft tissueInconclusivoAngiolipoma55BoneMetastasisMetastasis56BoneMetastasisMetastasis57Soft tissueBenign lesionMetastasis58BoneEliposarcomaAggressive fibromatosis60BoneBenign lesionAneurysmal bone cyst59Soft tissueLipomaLipoma61Soft tissueLipomaLipoma62BoneMetastasisMetastasis63BoneMetastasisMetastasis64BoneStrown tumourBrown tumour65BoneStrostencomaOsteosarcoma66BoneAgiosarcomaOsteosarcoma67BoneAgiosarcomaOsteosarcoma68BoneStrostencomAgiosarcoma69BoneStrostencomAgiosarcoma61BoneStrostencomAgiosarcoma63Bone <td< td=""><td>43</td><td>Bone</td><td>Metastasis</td><td>Metastasis</td></td<>	43	Bone	Metastasis	Metastasis
10bottinclusioninclusion46BoneChordomaMyeloma47BoneMyelomaMyeloma48BoneEnchondromaChordomsarcoma49BoneGiant Cell TumourGiant Cell Tumour50BoneInfectionInfection51BoneMetastasisMetastasis52BoneMetastasisMetastasis53BoneMetastasisMetastasis54Soft tissueIncolusivoAngiolipoma55BoneMetastasisMetastasis56BoneOsteosarcomaOsteosarcoma57Soft tissueBenign lesionHaemangioma58BoneBenign lesionAneurysmal bone Cyst59Soft tissueLiposarcomaAgressive fibromatosis60BoneBenign lesionAneurysmal bone Cyst61Soft tissueLipomaLipoma62Soft tissueLipomaMetastasis63BoneStown tumourBrown tumour64BoneStown tumourSchwannoma65BoneStown tumourSchwannoma66BoneStown tumourSchwannoma67BoneAgressive fibromatosis68BoneStown tumourSchwannoma69BoneStown tumourSchwannoma61BoneSchwannomaSchwannoma62BoneStown tumourSchwannoma63BoneSchwa	44	Bone	Metastasis	Metastasis
47BoneMyelomaMyeloma48BoneEnchondromaChondrosarcoma49BoneGiant Cell TumourGiant Cell Tumour50BoneInfectionInfection51BoneMetastasisMetastasis52BoneMetastasisMetastasis53BoneMetastasisMetastasis54Soft tissueInconclusivoAngiolipoma55BoneOsteosarcomaOsteosarcoma56BoneSoft tissueBenign lesionMetastasis57Soft tissueBenign lesionAneurysmal bone Cyst58BoneBenign lesionAneurysmal bone Cyst59Soft tissueLiposarcomaAggressive fibromatosis60BoneBenign lesionAneurysmal bone Cyst61Soft tissueLipomaSchwannoma62Soft tissueLipomaSchwannoma63BoneBrown tumourSchwannoma64BoneOsteosarcomaOsteosarcoma65BoneBoneBrown tumour66BoneSoft tissueInformatosis67BoneAgtiosarcomaAgtiosarcoma68BoneOsteosarcomaOsteosarcoma69BoneAgtiosarcomaAgtiosarcoma66BoneBoneAgtiosarcoma67BoneAgtiosarcomaAgtiosarcoma68BoneAgtiosarcomaAgtiosarcoma69BoneAgtiosarcoma<	46	Bone	Chordoma	Chordoma
48BoneEnchondromaChondrosarcoma49BoneGiant Cell TumourGiant Cell Tumour50BoneInfectionInfection51BoneMetastasisMetastasis52BoneMetastasisMetastasis53BoneMetastasisMetastasis54Soft tissueInconclusivoAngiolipoma55BoneMetastasisMetastasis66BoneOsteosarcomaOsteosarcoma57Soft tissueBenign lesionAneurysmal bone Cyst58BoneBenign lesionAneurysmal bone Cyst59Soft tissueLiposarcomaAggressive fibromatosis60BoneBenign lesionAneurysmal bone Cyst61Soft tissueLipomaLipoma62BoneBenign lesionMetastasis63BoneBenign lesionMetastasis64BoneBenign lesionMetastasis65BoneBoronunourSchwannoma66BoneBoneBrown tumour67BoneBoneSchusin tumour68BoneAngiosarcomaOsteosarcoma69BoneSoft tissueSchusin tumour66BoneAngiosarcomaOsteosarcoma67BoneAngiosarcomaOsteosarcoma68BoneAngiosarcomaAngiosarcoma69BoneAngiosarcomaAngiosarcoma69BoneAngiosarcomaAngiosarcoma </td <td>47</td> <td>Bone</td> <td>Myeloma</td> <td>Myeloma</td>	47	Bone	Myeloma	Myeloma
49 Bone Giant Cell Tumour Giant Cell Tumour 50 Bone Infection Infection 51 Bone Metastasis Metastasis 52 Bone Metastasis Metastasis 53 Bone Metastasis Metastasis 54 Soft tissue Inconclusivo Angolippoma 55 Bone Metastasis Metastasis 56 Bone Osteosarcoma Osteosarcoma 57 Soft tissue Benign lesion Metastasis 58 Bone Benign lesion Aneurysmal bone Cyst 59 Soft tissue Lipoarcoma Agressive fibromatosis 61 Soft tissue Lipoarcoma Agressive fibromatosis 62 Bone Ipoma Lipoma 63 Soft tissue Inconclusive Schwannoma 64 Bone Bone Schwannoma Schwannoma 65 Bone Schwannoma Schwannoma Schwannoma 66	48	Bone	Enchondroma	Chondrosarcoma
50BoneInfectionInfection51BoneMetastasisMetastasis52BoneMetastasisMetastasis53BoneMetastasisMetastasis54Soft tissueInconclusivoAngiolipoma55BoneMetastasisMetastasis66BoneOsteosarcomaOsteosarcoma57Soft tissueBenign lesionAneurysmal bone Cyst58BoneBenign lesionAneurysmal bone Cyst59Soft tissueLipomaAneurysmal bone Cyst61Soft tissueLipomaLipoma62Soft tissueLipomaMetastasis63BoneBoneMetastasis64BoneBoneSchwannoma65BoneStown tumourSchwannoma66BoneScown tumourBrown tumour67BoneExclusion tumourSchwannoma68BoneSclusion tumourSchwannoma67BoneExclusion tumourSchwannoma68BoneAngiosarcomaAngiosarcoma69BoneExclusion tumourExclusion tumour68BoneBoneSclusion tumour69BoneExclusion tumourExclusion tumour69BoneAngiosarcomaAngiosarcoma69BoneExclusion tumourExclusion tumour68BoneBoneMetastasis69BoneMetastasisMetastasis70 <td>49</td> <td>Bone</td> <td>Giant Cell Tumour</td> <td>Giant Cell Tumour</td>	49	Bone	Giant Cell Tumour	Giant Cell Tumour
51BoneMetastasisMetastasis52BoneMetastasisMetastasis53BoneMetastasisMetastasis54Soft tissueInconclusivoAngiolipoma55BoneMetastasisMetastasis56BoneOsteosarcomaOsteosarcoma57Soft tissueBenign lesionMetastasis58BoneBenign lesionAneurysmal bone Cyst59Soft tissueLiposarcomaAggressive fibromatosis60BoneRenign lesionAneurysmal bone cyst61Soft tissueLipomaLipoma62Soft tissueIconclusiveSchwannoma63BoneMetastasisMetastasis64BoneSrown tumourSchwannoma65BoneOsteosarcomaOsteosarcoma66BoneOsteosarcomaOsteosarcoma67BoneSclusion tumourExclusion tumour68BoneAggiosarcomaOsteosarcoma69BoneAggiosarcomaAngiosarcoma69BoneAggiosarcomaAngiosarcoma70BoneBenign lesionNon ossifying fibroma on71BoneMetastasisMetastasis72BoneMetastasisMetastasis73BoneMetastasisMetastasis73BoneMetastasisMetastasis74BoneMetastasisMetastasis75BoneMetastasisMetastasis <td>50</td> <td>Bone</td> <td>Infection</td> <td>Infection</td>	50	Bone	Infection	Infection
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73 Bone Inconclusive Osteosarcoma (continued on next page)	72	Bone	Metastasis	Metastasis
(continued on next page)	73	Bone	Inconclusive	Osteosarcoma
				(continued on next page)

Patient	Bone/Soft tissue tumour	Cytological diagnosis	Final diagnosis
74	Bone	Chondrosarcoma	Chondrosarcoma
75	Bone	Metastasis	Metastasis
76	Soft tissue	Lipoma	Lipoma
77	Bone	Metastasis	Metastasis
78	Bone	Giant Cell Tumour	Giant Cell Tumour
79	Bone	Metastasis	Metastasis
80	Soft tissue	Lipoma	Lipoma
81	Bone	Osteosarcoma	Osteosarcoma
82	Soft tissue	Ewing sarcoma	Ewing sarcoma
83	Bone	Myeloma	Myeloma
84	Bone	Inconclusive	Infection
85	Soft tissue	Lipoma	Lipoma
86	Bone	Inconclusive	Lymphoma
87	Soft tissue	Liposarcoma	Liposarcoma
88	Bone	Metastasis	Metastasis
89	Bone	Metastasis	Metastasis
90	Bone	Metastasis	Metastasis
91	Bone	Myeloma	Myeloma
92	Bone	Chondrosarcoma	Chondrosarcoma
93	Bone	Metastasis	Metastasis
94	Bone	Metastasis	Metastasis
95	Bone	Exclusion tumour	Exclusion tumour
96	Bone	Metastasis	Metastasis
97	Bone	Myeloma	Myeloma
98	Bone	Metastasis	Metastasis
99	Bone	Metastasis	Metastasis
100	Bone	Metastasis	Metastasis
101	Soft tissue	Giant Cell Tumor tendon sheaths	Giant Cell Tumor tendon sheaths
102	Bone	Metastasis	Metastasis
103	Soft tissue	Myxofibrosarcoma	Myxofibrosarcoma
104	Bone	Inconclusive	Enchondroma
105	Bone	Lymphoma	Lymphoma
106	Bone	Metastasis	Metastasis
107	Soft tissue	Inconclusive	Liposarcoma
108	Bone	Myeloma	Myeloma
109	Soft tissue	Inconclusive	Leiomyosarcoma
110	Bone	Inconclusive	Metastasis
111	Soft tissue	Мухота	Мухота
112	Soft tissue	Schwannoma	Schwannoma
113	Bone	Giant Cell Tumour	Giant Cell Tumour
114	Bone	Exclusion tumour	Exclusion tumour
115	Bone	Exclusion tumour	Exclusion tumour
116	Bone	Myeloma	Myeloma
117	Bone	Ewing sarcoma	Ewing sarcoma
118	Bone	Inconclusive	Chondrosarcoma
119	Bone	Metastasis	Metastasis
120	Soft tissue	Malignant lesion	Lipossarcoma
121	Soft tissue	Malignant lesion	Leiomyosarcoma
122	Bone Cofe theory	Cnondrosarcoma	Chondrosarcoma
123	Soft tissue	Benign lesion	Clear cell hidradenoma
124	Bone	Inconclusive	Osteosarcoma
125	Bone	Malignant lesion	Osteosarcoma
126	Bone	Metastasis	Metastasis
12/	Bone	Inconclusive	Ewing sarcoma
128	Bone	Malignant lesion	Ewing sarcoma
129	Soft tissue	Malignant lesion	Lipossarcoma
130	вопе	Inconclusive	IVIETASTASIS

Table 3

Diagnostic yield and diagnostic accuracy in bone and soft tissue tumours. p Values represent the difference between bone and soft tissue tumours.

	Overall	Bone tumours	Soft tissue tumours	p (bone vs soft tissue)
Diagnostic yield	(90/130) 69.2%	(71/94) 75.5%	(19/36) 52.8%	0.0187
Diagnostic accuracy	(87/90) 96.7%	(69/71) 97.2%	(18/19) 94.7%	0.05704

proven correct and in the other 9 in which malignancy had been excluded. This would be 96 of the 130 (73.8%) – Table 4. Considering the 6 biopsies without diagnosis but with the information of being malignant, 2 were soft tissue lesions. Even in these cases, treatment could have been done, as the great majority of soft tissue sarcoma protocols begin with surgical excision. Moreover, if the

treatment had been done according to the 3 wrong diagnoses, in these cases, the final result would not be considered a disaster.

Finally, caution should be taken in malignancies since the initial treatment is different according to each diagnosis. The utility of cy-togenetics in the routine work-up of sarcomas collected by FNA has been reinforced.¹⁶ It is possible, for instance, to confirm an Ewing

Table 4

Non-diagnostic results, cases in which a correct diagnosis was established and cases in which treatment was initiated in the overall cohort of patients and also in bone and soft tissue tumours. p Values represent the differences between the mean in bone and soft tissue tumours.

	Overall	Bone tumours	Soft tissue tumours	p (bone vs soft tissue)
Non-diagnostic results Establishing correct diagnosis	40/130 30.8% (87/130) 66.9%	23/94 24.5% (69/94) 73.4%	17/36 47.2% (18/36) 50.0% (22/32) 61 1%	0.0117 0.0109
Initiating treatment	(96/130) /3.8%	(74/94) 78.7%	(22/36) 61.1%	0.0412

sarcoma by the characteristic chromosome translocation t (11, 12) in samples of FNA. Nevertheless this was not done in this study.

In conclusion, despite the low diagnostic yield the accuracy of FNA was very high and would therefore permit the initiation of treatment in most cases, except in those in which the result suggests malignancy without a precise diagnosis.

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