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Review

Fibromatosis and Fibrosarcoma in Infancy and Childhood

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INTRODUCTION

NEOPLASMS AND pseudoneoplastic proliferations of fibroblasts and myofibroblasts form a large group of benign and malignant lesions which present as subcutaneous or deep tumour masses, often with alarmingly rapid growth. They display varying degrees of cellularity, collagen production and maturation to smooth muscle (Table 1), and to some extent, they overlap with those in which there are also histiocyte-like features, the so-called fibrohistiocytic tumours [1, 2]. Advances in histological techniques and contributions from cytogenetics and molecular genetics have enabled more accurate diagnosis, and changed our concepts of some established tumour types, while careful clinicopathological observations have defined the incidence and natural history of each entity. A number of these tumours are peculiar to younger age groups. Other tumours are found throughout life, but when occurring in infancy and childhood behave differently from the identical lesion in adults, with a benign outcome sometimes belying apparently aggressive histology. This is particularly so for the fibromatoses and fibrosarcoma, which form the subject of this review.

FIBROMATOSIS AND FIBROMATOSIS-LIKE LESIONS

The fibromatoses are characterised by proliferation of fibroblasts and myofibroblasts with marked collagen production. The cells are spindle-shaped or oval, bland and uniform, without pleomorphism or giant cells. Clinically, they are hard tumours which can infiltrate locally and recur, sometimes repeatedly and especially when incompletely excised, but which do not metastasise so that they are technically benign. However, when affecting vital structures, especially in head and neck, intra-abdominal or intrathoracic locations, they can be fatal because of inoperability. The common or desmoid-type fibromatoses can occur in any site, although the superficial ones are rarely seen in children. A number of childhood entities—infantile digital fibromatosis, hereditary gingival fibromatosis, fibromatosis colli—are localised and probably represent distinct disease processes.

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Infantile myofibromatosis is sometimes included within the fibromatosis category but is probably also a separate entity. Ultrastructurally [3], the fibroblasts and myofibroblasts in these lesions display a range of synthetic activity, manifested maximally by abundant dilated rough endoplasmic reticulum, which is related to type and amount of stroma. Immunohistochemically, they show vimentin and actin positivity and some display desmin, according to the subset of myofibroblast [4]. No aetiological factors are known, but cytogenetic abnormalities including loss of Y chromosome and abnormalities of 5q have been described in penile and palmar and deeper desmoids [5]. 5q abnormalities have also been found in patients with Gardner's syndrome (abdominal desmoid and intestinal polyposis) [5].

Desmoid-type fibromatosis [6]

This type usually arises as a solid mass in skeletal muscle or adjacent fascia or periosteum. It is found from birth to 5 years (mostly before the age of two), in the shoulder and upper arm, thigh or head and neck region, where sites of predilection include tongue, mandible and mastoid process, on occasion with involvement of the adjacent bone. Intra-abdominal fibromatosis, and some examples with multiple tumours, can be associated with Gardner's syndrome. The lesion is non-encapsulated, and infiltrates subcutaneous fat, sometimes reaching 10 cm in size. Histologically, several patterns reflect stages in the differentiation of fibroblasts. The immature or diffuse type (Figure 1), mostly seen in the youngest infants, is rather cellular, with primitive looking fibroblasts dispersed in a myxoid stroma, and infiltrates diffusely with lymphocytic infiltration and fat which replaces the muscle. The second form, which may overlap with the diffuse type, has more mature appearing fibroblasts in bundles and fascicles in a collagenous stroma; more cellular examples resemble infantile fibrosarcoma and have been described as the aggressive type of infantile fibromatosis [6]. Less cellular examples (Figure 2) occur in older children and resemble adult type desmoids.

Infantile digital fibromatosis

This type appears in the first 12 months, and sporadically later, as a smooth-contoured nodule, mostly on the distal or middle phalanges of the 3rd, 4th or 5th fingers or toes. The

Table 1. *Fibroblastic and myofibroblastic tumours and pseudotumours in paediatric age groups*

- Fibrous hamartoma of infancy
- Pseudosarcomatous lesions
  - Fasciitides
    - Nodular fasciitis
    - Cranial fasciitis
  - Inflammatory myofibroblastic tumour
    - Lung (inflammatory pseudotumour)
    - Bladder (fibromyxoid tumour)
    - Soft tissue
  - Calcifying fibrous pseudotumour
- Fibromatosis and fibromatosis-like lesions
  - Desmoid fibromatosis
    - Superficial — Palmar, plantar, penile
    - Deep — Intra-abdominal; Extra-abdominal
  - Fibromatosis colli
  - Infantile digital fibromatosis
  - Juvenile hyaline fibromatosis
  - Gingival fibromatosis
  - Calcifying aponeurotic fibroma
  - Infantile myofibroma and myofibromatosis
- Fibrohistiocytic tumours
  - Giant cell fibroblastoma
  - Dermatofibrosarcoma protuberans
  - Plexiform fibrohistiocytic tumour
  - Angiomatoid fibrous histiocytoma
- Fibrosarcoma
  - Congenital and infantile fibrosarcoma
  - Inflammatory fibrosarcoma
  - Infantile rhabdomyofibrosarcoma
  - Low grade fibromyxoid sarcoma
  - Sclerosing epithelioid fibrosarcoma

lesions may be multiple on one or more digits or extremities, but are rarely found on the sole or palm. They form circumscribed, firm, white masses of collagen, with interspersed uniform fibroblasts, extending deep into dermis. Some but not all of the fibroblastic and myofibroblastic cells contain the distinctive round, eosinophilic intracytoplasmic PAS-negative inclusions [7], 3–15 μm in diameter, which are possibly derived from actin microfilaments (Figure 3). Once thought to be exclusive to infantile digital fibromatosis, similar inclusions have now been reported in a variety of other soft tissue lesions with a myofibroblastic or smooth muscle component [8]. In approximately 60% of cases of infantile digital fibromatosis there is recurrence, either at the same site or as a new lesion in an adjacent digit, and usually within a few weeks. However, untreated lesions regress and the outcome is excellent.

Juvenile hyaline fibromatosis

This type is very rare, with only approximately 30 published cases in the literature, but may overlap with infantile systemic hyalinosis [9]. An autosomal recessive hereditary disease, it appears between 2 and 5 years of age, with new lesions continuing to form into adult life. There are multiple skin papules or nodules up to 5 cm in diameter, involving the head and neck (especially nose, ears and scalp), back and extremities. Sometimes there is bony involvement and muscle weakness, and MRI (magnetic resonance imaging) may be of value in assessing these cases [10]. The lesions, located in dermis, subcutis or gingiva, are poorly circumscribed masses of bland spindle cells, evenly dispersed in a homogenous pale or eosinophilic hyaline stroma (Figure 4), the proportion of which increases in older lesions. Treatment is surgical.

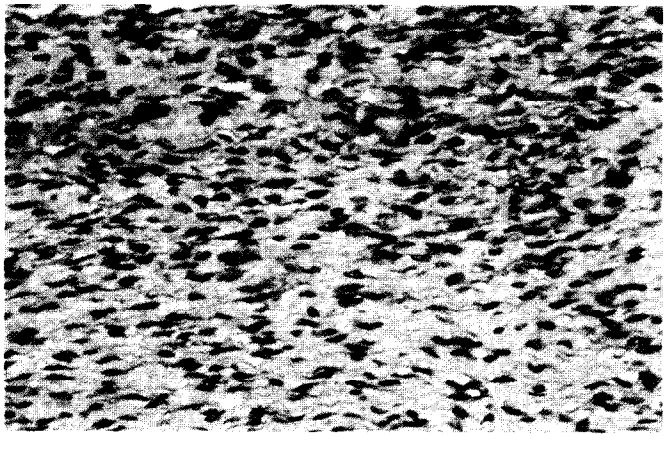

Figure 1. Desmoid-type fibromatosis of infantile type, with plump spindle cells in fascicles. H&E × 66.

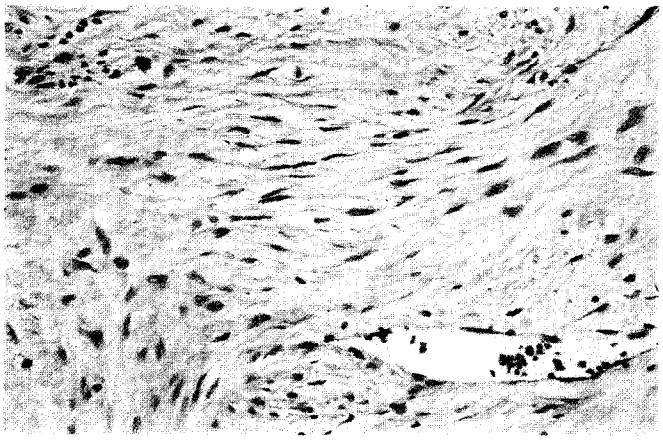

Figure 2. Desmoid-type fibromatosis, adult type, showing evenly dispersed slender myofibroblasts, mast cells and characteristic slit-like vessels with microhaemorrhages. This is from a lesion involving the inguinal region of a 5 year old boy. H&E × 66.

Gingival fibromatosis

This type is sporadic or, in around 36% of cases [11], familial with autosomal dominant or recessive inheritance. There is a slow-growing enlargement of the gums, which can be extensive and bilateral. It is frequently an isolated condition, but has been noted in examples of several rare eponymous syndromes, including those of Zimmermann-Laband (swelling of perioral tissues, nail hypo/aplasia, and abnormalities of terminal phalanges) [12] and Klippel-Trenaunay-Weber [13]. Gingival fibromatosis has also been associated with hypertrichosis and mental retardation [12], and in one patient with hearing deficiencies, hypertelorism, and supernumerary teeth [14].

Calcifying aponeurotic fibroma

This fibroma was previously known as juvenile aponeurotic fibroma [15]. It presents as a slowly growing firm painless mass in the hands or feet. Most examples occur in childhood or adolescence (median age of 12 years), and involve the hands, usually affecting the palm or fingers; approximately 15% arise in the feet, particularly in plantar or ankle regions. Sporadic sites include forearm, popliteal fossa, elbow, supraclavicular region, and lower back, generally with attachment to tendons or fasciae. The lesion is pale, up to 3.5 cm in diameter, with processes extending into subcutaneous fat and infiltrating around vessels and nerves. It is composed of fibrous tissue with bland plump myofibroblasts, sometimes in a linear or palisaded arrangement (especially near calcified areas), with variable amounts of focally hyalinised collagen. In addition, there are centrally located foci of calcification (detectable radiologically as a stippled pattern) and cartilage formation [16], sometimes with giant cells, and rarely with ossification especially in older children. The lesion is usually cured by excision, but occasionally recurs.

Fibromatosis colli

This type appears after the second week of life as a firm white mass in the sternal or clavicular portion of the lower third of the sternomastoid muscle. It is more frequent on the right side and in male infants. Perhaps half the cases arise following a breech or forceps delivery, but the occasional association with other malformations suggests that at least some examples are hamartomatous. This is a diffuse, bland, fibroblastic proliferation of varying cellularity and sclerosis, interspersed with residual atrophic and regenerating muscle fibres. Inflammation, necrosis, cytologic atypia and mitoses are lacking. After its initial rapid growth, the mass remains static but eventually regresses over a period of a year or so, without recurrence. Some, however, persist, and may require surgery, especially when torticollis occurs in the later phases.

Figure 3. Infantile digital fibromatosis, from a lesion on the ring finger of a 1 year old. Several cells contain rounded cytoplasmic inclusions. H&E × 200.

Figure 4. Juvenile hyaline fibromatosis, from a slowly growing subcutaneous nodule on the back of a 2 year old girl. This area shows abundant homogeneous, hyalinised stroma with scattered inactive fibroblasts. H&E × 66.

MYOFIBROMA AND MYOFIBROMATOSIS

This lesion, first described as congenital generalised fibromatosis, occurs in solitary and, less commonly, multicentric forms, and usually appears in the first year of life (particularly in the first 3 months), although it is seen from time to time in older children and also in adults. Some examples are familial. Solitary lesions occur on extremities or trunk and in the head and neck. When multiple, the process also involves deeper soft tissues, bones, and viscera including lung, GI tract, and myocardium, producing relevant symptoms. The cutaneous nodules, located in the dermis, can be large, some reaching 8 cm in diameter. Microscopically, myofibromas are unencapsulated and often display a zoning phenomenon. The central zone has sheets of polygonal cells (Figure 5) with scanty cytoplasm and mitoses, and peripherally there are bundles of smooth muscle-like cells (which are generally desmin-negative but actin-positive) arranged in short fascicles, with variable amounts of collagen. Other features seen include necrosis, calcification, and mature fat. There is often a characteristic haemangiopericytomatous vascular pattern in the centre of the tumour, sometimes with intravascular spread, and a relationship with infantile haemangiopericytoma has been postulated [17–19]. Solitary lesions sometimes undergo spontaneous regression, and this and the characteristic necrosis are possibly mediated by massive apoptotic cell death [20]. The lesion rarely recurs and the prognosis is good except for those patients with multiple visceral lesions.

FIBROSARCOMA

Fibrosarcoma is a malignant tumour showing purely fibroblastic and myofibroblastic differentiation, and differs from fibromatosis in having cellular pleomorphism, atypia and increased mitotic activity, as well as metastatic potential. However, fibrosarcoma before the age of 4 years is much less likely to metastasise than those in adults and indeed has more in common with infantile forms of fibromatosis. With increasing age, fibrosarcomas tend to behave more like their adult counterparts.

Congenital and infantile fibrosarcoma (CIFS)

CIFS [21] includes cases formerly considered separately as confined to congenital or infantile age groups [22–28]. This is a relatively rare tumour which appears usually in the first year of life, especially in the first 3 months, and nearly always before 4 years, and slightly more commonly in males. It presents as a painless, rapidly growing swelling which arises in deep soft tissues, and can become very large: some examples have reached a diameter of 20 cm, with erosion of the adjacent bone. The distal limbs are the usual locations, with fewer cases in the trunk or head and neck. The tumour has parallel or herring-bone fascicles of solidly packed, relatively uniform hyperchromatic spindle cells;

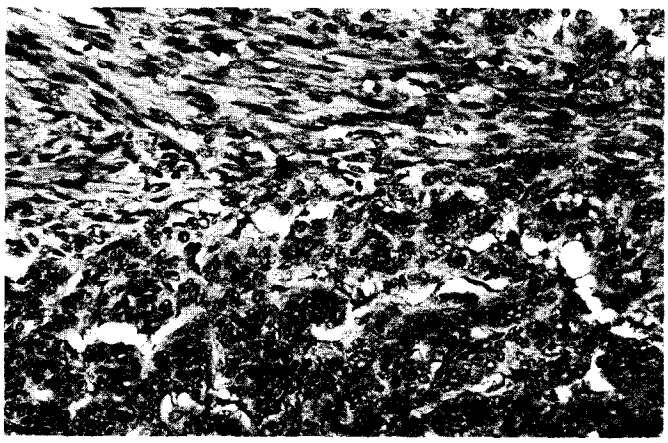

Figure 5. Infantile myofibroma. A cutaneous, centrally necrotic nodule on the shoulder of a girl aged 2 years. Polygonal cells, with haemangiopericytomatous pattern, merge into myoid spindle cell bundles. H&E × 66.

Figure 6. Infantile fibrosarcoma. This tumour, which involved the arm of a 2 year old boy, is composed of fascicles of closely packed spindle cells with mitoses. H&E × 132.

mitotic figures are quite common (Figure 6), but significant cytologic atypia is exceptional. The stroma has variable amounts of collagen, and a lymphocytic infiltrate, and haemorrhage (especially in vascular areas) and necrosis can be seen. Ultrastructurally, the cells are fibroblastic but immunohistochemistry [28] shows myofibroblastic differentiation in some with muscle specific actin and smooth muscle actin in 30% of cases, and desmin in 25%. CD34 and S100 protein positivity have been noted in a few examples. Chromosomal abnormalities reported in cases of infantile fibrosarcoma include trisomy 11 [29], random gains of chromosomes 8, 11, 17 and 20 [30–32], deletion of long arm of 17 [33]; and a t(12; 13) translocation [34]. This does not necessarily relate to malignant potential, as non-malignant tumours can have clonal chromosomal abnormalities in over a third of cases [35].

The diagnostic features are the uniformity of the cells, the solid growth pattern and fascicular arrangement with a lymphocytic infiltrate, and the absence of specific differentiation indicative of other tumour types. Compared with fibromatosis, CIFS is generally more cellular, more mitotically active and destructively expansile. However, cellular forms of fibromatosis can be virtually indistinguishable from fibrosarcoma, and tumours can start with the appearances of one and recur as the other. Measurement of proliferative activity (PCNA, p53 and DNA flow cytometry) [36] as well as AgNoRs [37], can sometimes assist the diagnosis. The distinction from fibromatosis is not necessarily critical, as both will behave and be managed more or less similarly (i.e. by adequate local excision), but it is important not to miss other, more aggressive malignancies such as rhabdomyosarcoma, synovial sarcoma and malignant peripheral nerve sheath tumour [38]. Therefore, in addition to careful morphological assessment, such tumours should routinely be examined by immunohistochemistry with a panel of appropriate antibodies, and samples taken from the fresh surgical specimen for electron microscopy and cytogenetic studies. Fibrosarcoma with marked inflammation also needs distinction, on morphological grounds, from inflammatory myofibroblastic tumour (see below).

The recurrence rate in CIFS is up to 30%, but metastases are rare, with a frequency of around 5% in published series [24, 25]. Indeed, no metastases were found in one recent series of 26 cases with adequate follow-up [39], although 6 of these patients died because of local complications of the tumour. Most cases of CIFS are diploid [39] and, unlike adult fibrosarcoma, the overall clinical course is favourable, with up to 94% 5 year survival, so that doubt has been cast on its terminology [39]. It can perhaps be regarded as a tumour of 'borderline' or low malignant potential, like most of the fibrohistiocytic tumours of this age group (Table 1). Despite the rapid growth and large size, the majority can be cured by wide local excision or amputation where unavoidable. No prognostic clinical or histological features have been identified for recurrence but, as with other soft tissue tumours, the ones which did recur had less radical and presumably inadequate initial treatment. Adjuvant radiotherapy and chemotherapy might only be indicated for inoperable, recurrent or metastatic cases.

Adult type fibrosarcoma

This type occurs in older children and differs from congenital-infantile fibrosarcoma both histologically, by the presence of gradable atypia and pleomorphism, and clinically by aggressive behaviour related to the usual factors of size, grade and depth from skin surface.

Recently described variants of fibrosarcoma

Inflammatory fibrosarcoma [40] is a tumour which involves principally the mesentery and retroperitoneum, but has also been described in the mediastinum, liver, diaphragm and abdominal wall, with a peak incidence in the first decade. In addition to focally atypical fibroblasts and myofibroblasts in sweeping fascicles or whorls, it displays marked inflammation, chiefly with plasma cells, and fibrosis and calcification. The lesional tissue can infiltrate through the bowel wall, causing mucosal ulceration. In the AFIP series [40], with follow up of 27 cases, 10 (37%) recurred, and 3 (11%) metastasised to lung or brain; 5 patients (19%) died of disease in a median time of 24 months.

This tumour requires distinction from inflammatory myofibroblastic tumour (inflammatory pseudotumour) [41], with which there may be some overlap. The latter has fasciitis-like, fascicular or sclerosing patterns, and is reported in the lung, bladder, head and neck and soft tissues, with a peak incidence in the second quinquennium. It has somewhat similar histological appearances to inflammatory fibrosarcoma, but lacks its pleomorphic nuclei, prominent

nucleoli and atypical mitoses. However, the clinical and pathological distinction between the two is not at present wholly clear cut.

3 patients, 2 females and 1 male between 1 and 3 years old, have been described with a predominantly fibrosarcomatous, desmoplastic and fascicular spindle-cell sarcoma, resembling infantile fibrosarcoma, but with ultrastructural and immunohistochemical evidence of rhabdomyoblastic differentiation, termed infantile rhabdomyofibrosarcoma [42]. Cytogenetically, these tumours displayed monosomy 19 (2/2), or monosomy 22 (1/2), thus differing from congenital fibrosarcoma and from the various rhabdomyosarcoma subtypes. Also, this neoplasm differs in several other respects from the recently described spindle-cell rhabdomyosarcoma [43]. Of the children, 2 died with metastases in 2 years, the other is alive but has local recurrence. The authors have suggested that the small numbers of infantile fibrosarcomas which metastasise might represent those which have rhabdomyoblastic differentiation.

Two further newly recognised variants of fibrosarcoma are only rarely encountered in childhood. Low grade fibromyxoid sarcoma [44] occurs in deeper soft tissues or abdomen, mostly of young adults and is characterised by benign-looking histology, which closely resembles that of desmoid fibromatosis but with a prolonged history of multiple recurrences and eventual metastasis, usually to lung. Sclerosing epithelioid fibrosarcoma [45], which arises in limbs and limb girdles, is composed of spindle and epithelioid fibroblasts and simulates an infiltrating carcinoma. This is also regarded as of low grade malignancy although approximately half the reported cases recurred, and over 40% metastasised.

1. Enzinger FM, Weiss SW. *Soft Tissue Tumors*, 3rd edn. St Louis, Toronto, London, CV Mosby Company, 1995, 7–9.
2. Weiss SW. *WHO International Histological Classifiation of Tumours. Histological Typing of Soft Tissue Tumours*. Berlin, Springer Verlag, 1994.
3. Erlandson RA. *Diagnostic Transmission Electron Microscopy of Tumors, with Clinico-pathological, Immunohistochemical and Cytogenetic Correlations*. New York, Raven Press, 1994, 178–179.
4. Skalli O, Schürch W, Seemayer T, *et al.* Myofibroblasts from diverse pathologic settings are heterogeneous in their content of actin isoforms and intermediate filament proteins. *Lab Invest* 1989, **60**, 275–285.
5. Bridge JA, Sreekantaiah C, Mouron B, Neff JR, Sandberg AA, Wolman SR. Clonal chromosomal abnormalities in desmoid tumors. Implications for histopathogenesis. *Cancer* 1992, **69**, 430–436.
6. Ayala AG, Ro JY, Goepfert H, Cangir A, Khorsand J, Flake G. Desmoid fibromatosis: a clinicopathologic study of 25 children. *Semin Diag Pathol* 1986, **3**, 138–150.
7. Hayashi T, Tsuda N, Chowdhury PR, *et al.* Infantile digital fibromatosis: a study of the development and regression of cytoplasmic inclusion bodies. *Mod Pathol* 1995, **8**, 548–552.
8. Hiraoka N, Mukai M, Hosoda Y, Hata J. Phyllodes tumor of the breast containing the intracytoplasmic inclusion bodies identical with infantile digital fibromatosis. *Am J Surg Pathol* 1994, **18**, 506–511.
9. Glover MT, Lake BD, Atherton DJ. Infantile systemic hyalinosis: newly recognized disorder of collagen? *Pediatrics* 1991, **87**, 228–234.
10. Jabra AA, Taylor GA. MRI evaluation of superficial soft tissue lesions in children. *Pediatr Radiol* 1993, **23**, 425–428.
11. Takagi M, Yamamoto H, Mega H, Hsieh KJ, Shioda S, Enomoto S. Heterogeneity in the gingival fibromatoses. *Cancer* 1991, **68**, 2202–2212.
12. Lacombe D, Bioulac-Sage P, Sibout M, *et al.* Congenital marked hypertrichosis and Laband syndrome in a child: overlap between the gingival fibromatosis-hypertrichosis and Laband syndromes. *Genetic Counselling* 1994, **5**, 251–256.
13. Hallett KB, Bankier A, Chow CW, Bateman J, Hall RK. Gingival fibromatosis and Klippel-Trenaunay-Weber syndrome. Case report. *Oral Surg, Oral Med, Oral Pathol, Oral Radiol & Endodontics* 1995, **79**, 578–582.
14. Wynne SE, Aldred MJ, Bartold PM. Hereditary gingival fibromatosis associated with hearing loss and supernumerary teeth—a new syndrome. *J Periodontol* 1995, **66**, 75–79.
15. Allen PW, Enzinger FM. Juvenile aponeurotic fibroma. *Cancer* 1970, **26**, 857–867.
16. Iwasaki H, Kikuchi M, Eimoto T, Enjoji M, Yoh S, Sakurai H. Juvenile aponeurotic fibroma: an ultrastructural study. *Ultrastructural Pathol* 1983, **4**, 75–83.
17. Mentzel T, Calonje E, Nascimento AG, Fletcher CDM. Infantile haemangiopericytoma versus infantile myofibromatosis—study of a series suggesting a continuous spectrum of infantile myofibroblastic lesions. *Am J Surg Pathol* 1994, **18**, 922–930.
18. Variend S, Bax NM, van Gorp J. Are infantile myofibromatosis, congenital fibrosarcoma and congenital haemangiopericytoma histogenetically related? *Histopathology* 1995, **26**, 57–62.
19. Dictor M, Elner A, Andersson T, Ferno M. Myofibromatosis-like haemangiopericytoma metastasizing as differentiated vascular smooth-muscle and myosarcoma. Myopericytes as a subset of 'myofibroblast'. *Am J Surg Pathol* 1992, **16**, 1239–1247.
20. Fukasawa Y, Ishikura H, Takada A, *et al.* Massive apoptosis in infantile myofibromatosis. A putative mechanism of tumor regression. *Am J Pathol* 1994, **144**, 480–485.
21. Coffin CM, Dehner LP. Fibroblastic-myofibroblastic tumors in children and adolescents: a clinicopathologic study of 108 examples in 103 patients. *Pediatr Pathol* 1991, **11**, 559–588.
22. Stout AP. Fibrosarcoma in infants and children. *Cancer* 1962, **15**, 1028–1040.
23. Dahl I, Save-Soderbergh J, Angervall L. Fibrosarcoma in early infancy. *Pathol Eur* 1973, **8**, 193–209.
24. Chung EB, Enzinger FM. Infantile fibrosarcoma. *Cancer* 1976, **38**, 729–739.
25. Soule EH, Pritchard DJ. Fibrosarcoma in infants and children. A review of 110 cases. *Cancer* 1977, **40**, 1711–1721.
26. Iwasaki H, Enjoji M. Infantile and adult fibrosarcomas of the soft tissue. *Acta Pathol Japonica* 1979, **9**, 377–388.
27. Salloum E, Caillaud JM, Flamant F, Landman J, Lemerle J. Poor prognosis infantile fibrosarcoma with pathologic features of malignant fibrous histiocytoma after local recurrence. *Med Pediatr Oncol* 1990, **18**, 295–298.
28. Wilson MB, Stanley W, Sens D, Garvin AJ. Infantile fibrosarcoma—a misnomer? *Pediatr Pathol* 1990, **10**, 901–907.
29. Bernstein R, Zeltzer PM, Lin F, Carpenter PM. Trisomy 11 and other nonrandom trisomies in congenital fibrosarcoma. *Cancer Genet Cytogenet* 1994, **78**, 82–86.
30. Sankary S, Dickman PS, Wiener E, *et al.* Consistent numerical chromosome aberrations in congenital fibrosarcoma. *Cancer Genet Cytogenet* 1993, **65**, 152–156.
31. Schofield DE, Fletcher JA, Grier HE, Yunis EJ. Fibrosarcoma in infants and children. Application of new techniques. *Am J Surg Pathol* 1994, **18**, 14–24.
32. Dal Cin P, Brock P, Casteels-Van Daele M, De Wever I, Van Damme B, Van den Berghe H. Cytogenetic characterization of congenital or infantile fibrosarcoma. *Eur J Pediatr* 1991, **150**, 579–581.
33. Gorman PA, Malone M, Pritchard J, Sheer D. Deletion of part of the short arm chromosome 17 in a congenital fibrosarcoma. *Cancer Genet Cytogenet* 1990, **48**, 193–198.
34. Strehl S, Ladenstein R, Wrba F, Salzer-Kuntschik M, Gadner H, Ambros PF. Translocation (12; 13) in a case of infantile fibrosarcoma. *Cancer Genet Cytogenet* 1993, **71**, 94–96.
35. Teyssier JR, Ferre D. Frequent clonal chromosome changes in human non-malignant tumors. *Int J Cancer* 1989, **44**, 828–832.
36. Oshiro Y, Fukuda T, Tsuneyoshi M. Fibrosarcoma versus fibromatoses and cellular nodular fasciitis. A comparative study of their proliferative activity using proliferating cell nuclear

antigen, DNA flow cytometry, and p53. *Am J Surg Pathol* 1994, **18**, 712–719.
37. Egan MJ, Raafat F, Crocker J, Smith K. Nucleolar organiser regions in fibrous proliferations of childhood and infantile fibrosarcoma. *J Clin Pathol* 1988, **41**, 31–33.
38. Meis JM, Enzinger FM, Martz KL, Neal JA. Malignant peripheral nerve sheath tumors (malignant schwannomas) in children. *Am J Surg Pathol* 1992, **16**, 694–707.
39. Coffin CM, Jaczcz W, O'Shea PA, Dehner LP. So-called congenital-infantile fibrosarcoma: does it exist and what is it? *Pediatr Pathol* 1994, **14**, 133–150.
40. Meis JM, Enzinger FM. Inflammatory fibrosarcoma of the mesentery and retroperitoneum. A tumor closely simulating inflammatory pseudotumor. *Am J Surg Pathol* 1991, **15**, 1146–1156.
41. Coffin CM, Watterson J, Priest JR, Dehner LP. Extrapulmonary inflammatory myofibroblastic tumor (inflammatory pseudotumor)—a clinicopathologic and immunohistochemical study of 84 cases. *Am J Surg Pathol* 1995, **19**, 859–872.
42. Lundgren L, Angervall L, Stenman G, Kindblom L-G. Infantile rhabdomyofibrosarcoma: a high-grade sarcoma distinguishable from fibrosarcoma and rhabdomyosarcoma. *Hum Pathol* 1993, **24**, 785–795.
43. Cavazzana AO, Schmidt D, Ninfo V, *et al.* Spindle cell rhabdomyosarcoma. A prognostically favourable variant of rhabdomyosarcoma. *Am J Surg Pathol* 1992, **16**, 229–235.
44. Evans HL. Low-grade fibromyxoid sarcoma. A report of 12 cases. *Am J Surg Pathol* 1993, **17**, 595–600.
45. Meis-Kindblom JM, Kindblom L-G, Enzinger FM. Sclerosing epithelioid fibrosarcoma. A variant of fibrosarcoma simulating carcinoma. *Am J Surg Pathol* 1995, **19**, 979–993.