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RESEARCH ARTICLE

SPINDLE CELLS: HISTOLOGY & STRUCTURE – AN INSIGHT

[1]Dr. Manasa Ravath, C. J., [1,*]Dr. Noopur Managoli, [2]Dr. Shailesh Gawande and [3]Dr. Sujit Londhe

[1]Department of Oral Pathology & Microbiology, PDUDC Kegaon, Solapur
[2]MDS Oral Pathology and Microbiology, Consultant Dentist, Akola
[3]MDS Oral Pathology and Microbiology, Consultant Dentist, Pune

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ABSTRACT

The connective tissue has a characteristic morphology. Spindle cells are one such group of cells which have a unique variation & its appearance is exhibited by various cells. A few of them are fibroblast, myofibroblast, smooth muscle cells, pericytes & so on. The cellular architecture, histomorphology, ultrastructural properties, immunohistochemistry & other salient features have been described in our paper. Also this paper is an attempt to assemble almost all the spindle cells together under one draft. A variety of sub population of a few of these cells have an enormous role & influence on the oral epithelium (both in Physiology & Pathology). These interesting spindle cells have a pivotal role which lead to many pathologies. This demands to increase the necessity to shift focus in the area of Spindle cell lesions also, which all together is a different segment of Head & Neck Pathology

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INTRODUCTION

Cellular components of the connective tissue are of varied histomorphology. Amongst the gamut of the types of cells seen, the spindle cells are the ones which exhibit a lot of variation & also the similar 'spindled' appearance is shown by different types of cells. The spindle cells are fusiform in shape with cytoplasmic extensions away from the nucleus in one or two directions. They vary in size having a moderate amount of light to medium blue cytoplasm. The nucleus of the cell is round to oval in shape and stains with medium intensity and has a smooth to fine lacy chromatin pattern. The nucleoli usually are not visible in non-neoplastic spindles. When the spindle cells are malignant, their nucleoli become more prominent while the shape of these cells becomes less prominent. The cellular, nuclear and nucleolar size and shape vary markedly in such cells. The chromatin pattern becomes coarse, and the cytoplasm basophilic with increase in nuclear cytoplasmic ratio[1]. Some of the physiological cells which exhibit spindle morphology are fibroblast, myofibroblast, smooth muscle cells, myoepithelial cells, perineural cells, pericytes, schwann cells and myoepithelial cells[2]. These various types of spindle cells have specific morphological & immunohistochemical properties which are assimilated here.

****Corresponding author: Dr. Noopur Managoli,***
Department of Oral Pathology & Microbiology, PDUDC Kegaon, Solapur

Types of spindle cells

Fibroblast

Fibroblasts are prominent cells of the fibrous connective tissue. These cells have a pale staining smoothly contoured oval shaped nuclei, one or two nucleoli and eosinophilic to basophilic cytoplasm, depending on the state of their synthetic activity. The cytoplasmic borders are usually indistinct. The cells produce fibers and amorphous ground substance of ordinary connective tissue. At the stage when they are actively secreting intercellular substances, they either possess widely spaced cytoplasmic processes or appear spindle shaped. The same cells become less active during adult life and are referred to as fibrocyte[3]. In H&E sections, it is impossible to distinguish the attenuated and poorly preserved fibroblast cytoplasm from the collagen fibers, thus typically only the nuclei of these cells are evident[2]. Recent evidence suggests the presence of heterogeneity in the fibroblast population. The subtypes have been identified in different parts of the body based on their genetic expression[4]. Fibroblasts are indispensible as the soldier cells in wound healing. They produce the major extracellular matrix [ECM] components in the process of healing. The fibroblasts in wound healing process change their phenotype into a 'profibrotic type' under the influence of TGF-β1 to synthesize the matrix. Studies have attempted to explain the force generated by fibroblasts to contract a wound. Gabbiani *et al* postulated a 'myofibroblast

theory' which explains a smooth muscle cell like fibroblast which is responsible for ECM contraction.

Another 'fibroblast theory' was proposed by Harris *et al* which says that the fibroblasts realign the collagen fibrils in the healing wound as they migrate causing wound contraction[5]. Cell culture studies of fibroblasts on planar surfaces have shown that they exhibit motility[6]. The vital role of fibroblasts in wound healing in terms of secreting extracellular matrix, extracellular cytokines & tissue mechanical properties cannot be overemphasized. They have also been found to have interactions with the epithelium and regulate the epithelial phenotype including pigmentation[4]. Referred to as mesenchymal cells or pulpoblasts or pulpocytes depending on their stage of maturation by Baume, the fibroblasts of the dental pulp have been found to take part even in calcification as seen in ageing pulp. This characteristic is not exhibited by the regular connective tissue fibroblasts[7]. Costea *et al* have studied & demonstrated the role of fibroblasts in the reconstitution & healing of keratinocytes of the oral epithelium. They could also demonstrate the presence of various subpopulations of these cells which have variable influence on the differentiation of oral epithelial cells both in health & neoplastic process[8].

Fibrocyte

The resting cell also called 'fibrocyte' was first described in 1994 as a circulating bone marrow derived cell which shows mesenchymal differentiation. They exhibit morphology of both the fibroblast & monocyte, thereby the term combining fibroblast &leukocyte. Comprising about 0.5% of the circulating leukocytes & 0.5 -1% of nucleated cells in the peripheral blood, in a normal host, their number increases following a rise in cytokines & chemokines in fibrotic & inflammatory conditions, thereby these cells contribute in the formation of granulomas, hypertrophic scars & tissue remodelling [9,10].

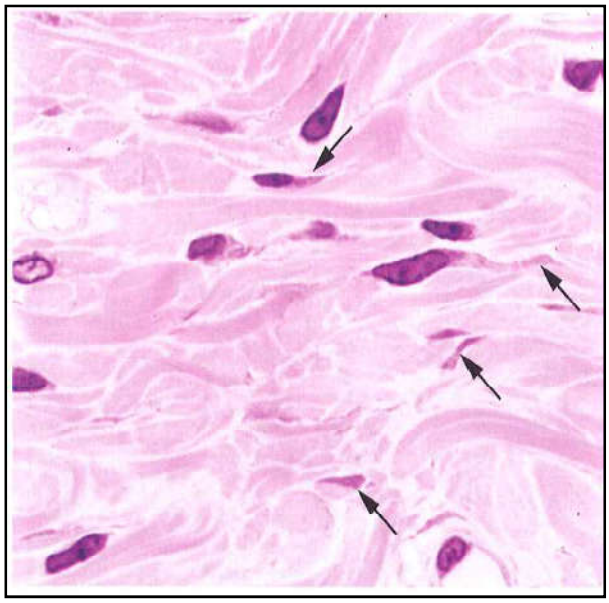

Figure. H&E section showing fibroblast in connective tissuethe arrows represent thin strands of fibroblast cytoplasm

They are a distinct cell population different from the monocytes, dendritic cells, T lymphocytes, fibroblasts, epithelial cells, endothelial cells & langerhans cells [10].

They have been found to differentiate into adipocytes, myofibroblast-like cells, osteoblasts & even chondrocytes. They exhibit a number of markers including CD34, CD45 (LCA), collagen 1 & fibronectin based on which studies on such mesenchymal stem cells & their role in gene therapy & tissue regeneration have gained newer grounds. They express markers like CXCR4 taking part in wound healing, functioning as antigen presenting cells also activate pathologic fibrosis [11].

Myofibroblast

The myofibroblast is a mesenchymal cell with predominantly spindle morphology in histological and ultrathin sections, described initially in granulation tissue, and regarded as having a role in wound healing. The simplest definition of myofibroblast is that they are smooth muscle like fibroblasts. They are pivotal cellular components of normal and abnormal wound healing, reactive fibroblastic proliferative conditions, and the stroma of certain neoplasms [12]. The fibrocytes differentiate into myofibroblast in response to TGF – β or endothelin – 1 & also express the myofibroblast marker α-SMA [10]. The differentiated myofibroblast is responsible for wound contraction due to the parallel actin fibril contracting the cell similar to muscle [5].

The rich cytoplasmic actin microfilaments also known as 'actin-rich stress' fibers & the alpha smooth muscle actin also called 'stress' fibers cause the cells to contract like a smooth muscle cell. The synchronized contraction which the myofibroblast exhibits is due to the two different types of fibrils [4]. Atleast three local events have been found to be a prerequisite for differentiation of the cells as follows: 1) accumulation of biologically active TGF-β 2) presence of specialized ECM proteins 3) high extracellular stress. The recognized cells which serve as myofibroblast precursors are the local fibroblasts, pericytes, epithelial cells, endothelial cells & smooth muscle cells. Also epithelial mesenchymal cross-talk leading to myofibroblast transformation has also been identified as a source of these cells [13].

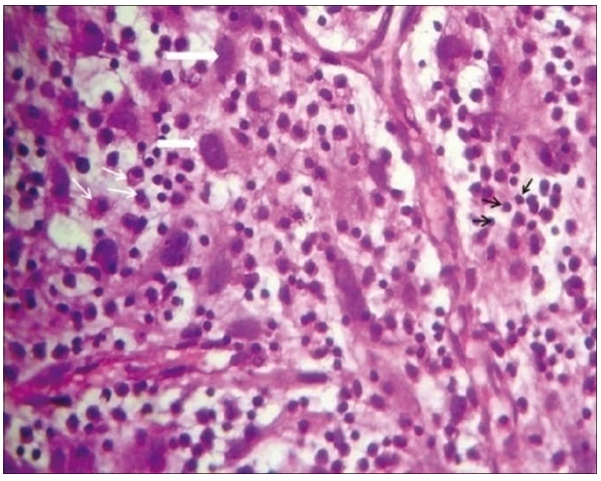

Figure. High-power view showing myofibroblasts with plump oval nuclei (thick white arrows), plasma cells (thin white arrows) and inflammatory cells, mainly lymphocytes (black arrows) in a collagenous background with myxoid areas

Pericytes

These cells were first accounted by Eberth (1871) though the credit is given to the French scientist Charles-Marie Benjamin Rouget who described them as the contractile cells around the small blood vessels (1873). These cells were named as Rouget

cells by Zimmermann who later coined the term pericytes (1923) [14]. The cells of the walls of the blood vessels are the mural cells or the pericytes (Hammes, 2002). They are often mistaken for other periendothelial cells like vascular smooth muscle cells, fibroblasts, epithelial cells & macrophages. A mature pericyte is defined as an extensively branched cell located in non-muscular microvessels, capillaries & post capillary venules, embedded in the microvascular basement membrane, incompeletely enveloping the endothelial cells with which they establish specific focal contacts [16]. These cells exhibit a stellate morphology with elongated processes extending from round to oval perinuclear region or cell body. The relative number of pericytes varies from organ to organ & they have been found in great abundance in the vasculature of CNS & very low numbers have been found in the human skeletal muscle tissue. The loss of pericytes have been associated with pathological conditions & even demonstrated in gene targeted mouse mutants [14,15]. The cell contacts between the pericytes & the endothelial cells may extend beyond the respective capillary & is also vital for the integration of the cell signals & expression of growth factors required for the formation & maintenance of the blood vessels [17].

Smooth muscle cells

These are fusiform in shape with tapered ends, occasionally bifurcated and have centrally located cylindrical nuclei with round ends. The nuclei may appear spiral-shaped depending on the contractile state of the cell when fixed. The length of the cells varies depending on the organ. The cells are usually arranged in fascicles in which the nuclei are staggered. These fascicles are the functional contractile units comprising numerous individual cells closely packed along each other with the thick central portion of one cell closely abutting the thin portion of the adjacent cell [18]. The cells vary considerably in size with their location, the smallest are approximately 30µm long and lie in the walls of small blood vessels. The nucleus is single and centrally placed in the widest part of the fiber [3, 19].

Myoepithelial cells

Myoepithelial cells are normal constituent of the major and minor salivary glands. Microscopic examination shows that myoepithelial cells are thin and spindle shaped cells situated between the basement membrane and epithelial cells present on the outer aspect at all levels of the ducts & acinar units. Dardick has postulated that during the evolutionary development of these cells of the salivary glands, the more distally placed basal cells acquired muscle specific actin and structurally got modified into typical my epithelial cells. They display a hybrid nature having features of both smooth muscle & epithelium suggesting a contractile function [20]. They also demonstrate microfilaments with focal densities in the cytoplasm processes, and desmosomes which attach the myoepithelial to the epithelial cells [21]. They exhibit diversity of form even in the same species, but in relation to the salivary acini they present with a stellate shape having numerous long, sometimes branched cytoplasmic extensions which are tightly bound around the acinar cells via desmosomes [21,22]. This structural relationship with the epithelial cells has earned them the name 'basket' cell [23]. They are more fusiform in shape having fewer cell processes in association with the intercalated duct cells. Actin & soluble myosin filaments are seen in the cytoplasmic processes with the other cellular organelles located in the perinuclear cytoplasm[22].

Schwann cells

Schwann cells or neuralemmocytes are principal glia of the peripheral nervous system derived from the neural crest cells during embryogenesis [22,23]. They were named so in honour of Theodor Schwann, a German physiologist, considered the founding father of modern histology, who described these cells in detail. They are further grouped as schwann cells that form myelin, & that do not form myelin. They are highly specialized cells which participate in both structural & metabolic homeostasis. They are now known to participate in healing & repair including pain perception [24]. The myelinating schwann cells are very important cells actively involved in physiology & repair [22]. The incredible ability of the peripheral nerve system to repair & regenerate itself in case of injury has major contribution of the schwann cells along with the neuronal cells [25]. A well-developed Schwann cell is shaped like a rolled up sheet of paper, with layers of myelin in between each coil [21]. Van Geren has described the spiralling pattern of myelination that each schwann cell spiral is in the opposite direction of the adjacent cell. EM studies have revealed presence of 'major dense lines' which are a result of the fusion of cytoplasmic leaflets following compact arrangement of the cell membrane. Intervening 'intraperiod lines' are seen which represent closely apposed external membrane leaflets. In case of damage, the myelinating cells' architecture is altered. They also function as antigen presenting cells expressing many immunomodulatory receptors. This immune- reactivity of the cells may result in the demyelination of cells & signal non -conduction. In the recent times, the perisynaptic schwann cells have been understood to be actively involved in the formation, function, maintenance & repair of the chemical activity seen in the neuromuscular junction [24]. In H&E preparations, the peripheral nerve fibers in longitudinal sections show fascicles invested by the perineurium. The spindle cells which appear in these sections are comprised of both the Schwann cells & fibroblasts of the endoneurium, both following a wavy course of the axons.

Conclusion

It is thus evident from the above mentioned data that these spindle cells are a unique group with a characteristic histomorphology. A thorough description of these spindle cells has been given in our paper. A complete understanding of these morphologically diverse cells has to be underlined because of their different roles both in Histology & Pathology.

REFERENCES

1. Cowell, R. L., Tyler, R. D. 2002. Cytology and hematology of the horse.2nd ed. USA: Mosby; p.36.
2. Ross, M. H., Pawlina, W. 2006. Histology a text and atlas with correlated cell and molecular biology.5th ed. USA: Lippincott Williams & Williams.
3. Cormack, D.H. 1987. Ham's Histology. 9th ed. Philladelphia: JB Lippincot.
4. Phan, S.H. 2008. Biology of fibroblasts & myofibroblasts. *Proc Am Thorac Soc*., Vol 5.p 334–337.
5. Porter, S. 2007. The role of of the fibroblast in wound contraction & healing. Wounds UK, Vol. 3, No 1. p 34-40.
6. Grinnell, F., Ho, C.H., Tamariz, E., Lee, D.J., Skuta, G. 2003. Dendritic fibroblasts in three-dimesnsional collagen matrices. *Molecular Biology of the Cell*, Vol. 14, Feb, p384–395.

7. Pashley, D.H., Walton, R.E., Slavkin, H. Histology & physiology of the dental pulp. Endodontics. p25-38. 5th ed, 2002.
8. Costea, D.E. 2005. Epithelial - mesenchymal interactions in normal and neoplastic human oral mucosa. A study on in vitro organotypic models. University of Bergen, Norway
9. Herzog, E., Bucala, R. 2010. Fibrocytes in health & disease. *Exp Hematol*., July ; 38(7): 548–556
10. Keelay, E.C., Mehrad, B., Strieter, R.M. 2010. Fibrocytes: bringing new insights into mechanisms of inflammation & fibrosis. *Int J Biochem Cell Biol*., April ; 42(4): 535–542
11. Choi, Y.H., Burdick, M.D., Strieter, R.M. 2010. Human Circulating Fibrocytes Have The Capacity To Differentiate Osteoblasts And Chondrocytes. *Int J Biochem Cell Biol.,* May ; 42(5): 662–671
12. Eyden, B. 2001. The fibronexus in reactive & humoral myofibroblast: further characterization by EM. *Histol Histopathol.,* 16:57-70.
13. Spaeth, E.L., Dembinski, J.L., Sasser, A.K., Watson, K., Klopp, A., Hall, B., Andreeff, M., Marini, F. 2009. Mesenchymal Stem Cell Transition to Tumor-Associated Fibroblasts Contributes to Fibrovascular Network Expansion and Tumor Progression. Plosone, April, Volume 4, Issue 4, p-4992.
14. Armulik, A., Genove, G., Betsholtz, C. 2011. Pericytes: developmental, physiological, & pathological perspectives, problems & promises. Developmental Cell 21, August 16, [a]2011 Elsevier Inc. 193-215.
15. Hammes, H.P. *et al*. 2002. Pericytes and the Pathogenesis of Diabetic Retinopathy. Diabetes, vol 51, Oct, pg 3107-3112.
16. Florez, L.D. *et al*. 2009. Pericytes. Morphofunction, interactions and pathology in a quiescent and activated mesenchymal cell niche. Histol Histopathol 24: p.909-969.
17. Bergers, G., Song, S. 2005.The role of pericytes in blood-vessel formation and maintenance. *Neuro-Oncology*, July, p 452-464.
18. Young B, Lowes JS, Stevens A, Heath JW, Deakin PJ. Wheaters functional histology. *Elsevier Health Sciences*. 2006. 5th ed p 110-112.
19. Ross, R.1971. The smooth muscle cell. II. Growth of smooth muscle in culture and formation of elastic fibers. *J Cell Biol.,* 50:172.
20. Dardick, I. 2003. Current concepts of histogenetic & morphogenetic
21. Juqueria LC, Carneiro J. Basic histology test book and atlas 10thed. New York, NY: McGraw-Hill Co.
22. Nanci A. Tencate's oral histology development, structure & function. 7th ed, Mosby; 2008, p 64-66.
23. Kumar GS. Orban's oral histology & embryology. 12th ed, Elsevier 13th ed, p 160-163, 121-129, 263-264.
24. Armati, P.J., Mathey, E.K. 2013. An update on schwann cell biology – immunomodulation, neural regulation & other surprises. *Journal of Neurological Sciences*, 333, p 68-72.
25. Armati PJ, Mathey EK. 200. Introduction to the Schwann cell. Cambridge University Press 978-0-521-85020-9. The Biology of Schwann Cells: Development, Differentiation and Immunomodulation.

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