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Original Article

Gross and microscopic study of insertion of levator palpebrae superioris and its anatomical correlation in superior palpebral crease formation and its clinical relevance

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ABSTRACT

Background: To study insertion of LPS and correlate anatomically the formation of superior palpebral crease and its clinical relevance in section of Indian population.
Methods: Twenty-five human eyelids from cadavers ranging from 15–80 years were studied by dissection and histology.
Results: The levator aponeurosis traverses through interfascicular space of orbicularis oculi with twenty four inserting into subcutaneous tissue. Low septo aponeurotic sling or pre-aponeurotic fat was not observed. Lower one third tarsal insertion seen in twenty four specimens. Fibres become denser as it reaches the connective tissue anterior to tarsal plate. The crease was at different levels in relation to the tarsal insertion.
Conclusion: The aponeurosis insertion is either to the skin, the subcutaneous tissue or into the interfascicular space of the orbicularis. The present study reaffirms the insertion of LPS to the subcutaneous tissue of the eyelid with an extension reaching lower one third of the tarsal plate. The tissues in the anterior tarsal plate are closely packed but to act as a single complex to form a dynamic crease has not been confirmed in the study. No gross or histological difference was observed in the skin of the eyelid in the vicinity of the crease. The pattern of insertion of LPS aponeurosis plays a direct role in the formation of superior palpebral crease an important role in surgeries for Ptosis. The eyelids studied were of Indian origin with crease, and further comparative studies needs to be done for the precise anatomical explanation of single fold eyelids.

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Introduction

The extra ocular or extrinsic muscles of eyelid includes an elevator of the upper eyelid, the levator palpebrae superioris (LPS) which is a delaminated part of superior rectus (SR).[1] LPS is a thin triangular muscle which arises from inferior surface of lesser wing of sphenoid, above and anterior to optic canal and separated from it by the attachment of superior rectus. It has a short narrow tendon at its posterior attachment, broadens gradually as it passes anteriorly above the eyeball and ends in a wide aponeurosis. Some of its tendinous fibres pass straight into the upper eyelid to insert into the anterior surface of tarsus while rest of the fibres radiate, piercing the orbicularis oculi to reach the skin of upper eyelid.[2,3] Close to the origin, the connective tissue coat of the adjoining surfaces of LPS and SR are fused and the fascia between them is attached to the superior conjunctival fornix, which is described as an additional attachment of LPS. The Superior Tarsal muscle (Muller's muscle), which arises as a smooth muscle ends in a fibrous extension to the upper margin of superior tarsus. This muscle, receives a sympathetic innervation from the superior cervical ganglion. The role of Superior Tarsal muscle is less clear, however in Horner's syndrome, it causes Ptosis of upper eyelid. The Muller's muscle has also been described as one of the attachments of LPS originating from the inferior surface of LPS,[4,5] however, some studies do not mention of Superior Tarsal muscle as part of LPS,[6,7] while some mention its insertion into the superior edge of tarsus.[8]

LPS has a levator action on the upper eyelid, its antagonist being palpebral part of orbicularis oculi.[1] LPS aponeurosis arising from the point of fusion of LPS and lower part of orbital septum (forming the septo aponeurotic sling), extends downwards into the lid and attaches with the tarsus and the connective tissue of the orbicularis in front of it.[9] The aponeurosis has also been described to have three lamellae – superficial, middle and deep, getting inserted to front of superior tarsus, on the upper border of tarsus and superior fornix respectively.[10] In addition, collagen fibres from the aponeurosis of LPS pass between bundles of orbicularis oculi, referred to as interfascicular space, and gets inserted into the skin of the upper eyelid.[11] Some other studies with similar interpretation justify their pretarsal part to attach into the skin of upper eyelid crease and sending septa in a diffuse pattern to the entire pretarsal portion of orbicularis[12] referred to as ''superficial lamina''[13] with a deeper lamina inserting on lower anterior surface of tarsal plate, while the deepest fibres reaching the superior conjunctival fornix as described previously.[5,14] The LPS aponeurosis may also be absent in the pretarsal part by terminating in the superior tarsal border with some role in the elevation of the eyelid.[15,16] Cheng et al[17] studied the presence of the aponeurosis in the subcutaneous tissue of the upper eyelid leading to the formation of superior palpebral crease. Interestingly, eyelids without a crease have been postulated due to the inability of the aponeurosis to reach the skin due to excess preaponeurotic fat and lower fusion of orbital septum and levator aponeurosis[16,18] while eyelids with crease may be due to strong adherence of pretarsal tissues.[19] Recent studies on eyelid demonstrate the orbital septum fusion with the LPS fibres i.e. the septo aponeurotic sling above the tarsal plate thus enabling the fibres to reach the pretarsal region of the eyelid[20] and the presence of crease attributed to thinner skin and orbicularis.[21] The hypothesis of a strongly adherent pretarsal tissue has been refined to include a tight skin-orbicularis-tarsus complex which is lifted up as a single entity during opening of lid eye leading to formation of dynamic crease.[22] The studies done till date on LPS aponeurosis and their varied patterns of insertions with reference to orbital septum, preaponeurotic fat, tight pretarsal tissue complexes, thinner skin etc exhibits multiplicity of hypotheses and findings. The studies have been done on double fold (with superior palpebral crease) eyelids of the west and single fold (without crease) eyelids of East Asians with peculiarities of each contributing to formation of crease with their associated clinical implications. However, there are no studies conducted amongst Indian population (which differs from the typical Western and East Asian race) to analyze and correlate the findings of the previous studies. The present aim of the study attempts to analyze the qualitative data obtained from cadaver eyelid by dissection and microscopic study of the levator insertion in a section of Indian population and to find the anatomical basis for the formation of superior palpebral crease. The study endeavours to prove that the superior palpebral crease is associated with the peculiar attachment of the LPS fibres into the upper eyelid and analyze the findings of different authors in an Indian context.

Material and methods

Twenty five human eyelids ranging from 15 years to 80 years were studied. The specimens were collected from cadavers obtained from a local hospital. Eyelid specimens were immediately kept in 10% formalin and dissection was carried out. All specimens were processed for paraffin section histological analysis. Orbits were cut in the midline parallel to the medial wall of the orbit by an electric saw (Fig. 1) and a macroscopic study of gross anatomy of LPS was done. The eyelids were extracted from the orbits and a strip was cut in the middle of the upper eyelid for histological study.

The specimens were then kept individually in vials containing 10% buffered formalin, decalcified (with 10% formic acid), and then prepared for sectioning through an Alcohol-Xylol-Paraffin wax sequence. Sections of 4–5 microns were examined with Haematoxylin and Eosin and Masson's trichrome stain (for collagen fibres).

Results

The observations are grouped under Cutaneous insertion, Tarsal insertion, Superior fornix and Muller's muscle. The data on insertion of the LPS has been recorded in a tabular form (Table 1).

The bony origin of LPS is not disputed. LPS continues as levator aponeurosis while the posterior lamella continues as the smooth muscle of Muller. The aponeurosis arises from the striated muscle of LPS. The preaponeurotic fat separates the levator aponeurosis from the connective tissue fibres of the orbital septum at upper levels (Fig. 2) and subsequently fuses