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Is Lateral Tarsal Strip the Method of Choice in Treating Involutional Lower Eyelid Entropion?

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Summary: Lower eyelid entropion is malposition of the lower eyelid, potentially leading to loss of vision. The most common causes of entropion are involutional changes, less often cicatricial or paralysis factors. In order to treat involutional entropion there are multiple surgical techniques, referred to its cause, which may be vertical laxity, horizontal laxity or migration of orbicularis oculi muscle. Preoperative examination is the key to choosing proper technique. The most common surgical technique is Lateral Tarsal Strip, which refers to horizontal laxity, the main factor of involutional entropion. Although this technique is described as a successful method, when performed alone may not be sufficient. In order to increase the effectiveness and lower recurrent rate, there are combined methods, such as: everting sutures or lower eyelid retractor plication. This study aims to compare selected entropion surgical techniques and to present the effectiveness of combining Lateral Tarsal Strip with other methods. Described combined techniques may be the gold standard in the surgical treatment of involutional lower eyelid entropion.

Key words: involutional entropion, lateral tarsal strip (LTS), horizontal laxity, vertical laxity, everting sutures (ES), retractor plication.

I. Introduction: What is entropion – epidemiology, symptoms

Entropion is a medical condition in which the lower eyelid is abnormally positioned, causing its free margin to rotate inward toward the eyeball [1, 2]. It can be either congenital or acquired. Acquired entropion is most commonly caused by involutional changes and, less frequently, by cicatricial or paralytic changes [3]. Entropion affects approximately 2.1% of individuals over 60 years of age, with a slightly higher prevalence in women (2.5%) compared to men (1.9%). These sex-based differences are attributed to variations in the size of the tarsus and the position of the eye within the orbit [3].

Lower eyelid entropion is a potentially vision-threatening condition that causes chronic friction of the skin and eyelashes over the cornea and bulbar conjunctiva. This leads to eye redness, excessive tearing, a foreign body sensation, and blurred vision. If left untreated, the condition can progress to corneal neovascularization and keratopathy. In more severe cases, it may result in corneal ulceration and perforation [1, 4].

Conservative treatment options – including moisturizing eye drops, bandage contact lenses, lower eyelid taping, and botulinum toxin injections – provide only symptomatic relief. Achieving a lasting correction requires surgical intervention aimed at restoring the proper position of the lower eyelid [1, 5, 6]. Given the multifactorial nature of entropion, the key to selecting the appropriate surgical approach lies in identifying the specific factors that contribute to the malposition of the lower eyelid. The aim of this paper is to compare selected operative methods for entropion repair and to highlight the effectiveness of combining various surgical techniques using the lateral tarsal strip (LTS) procedure, which may represent the gold standard for treating involutional entropion.

II. Eyelid anatomy and factors causing entropion

In anatomical terms, the lower eyelid can be divided into the anterior lamella, composed of the skin and orbicularis oculi muscle, and the posterior lamella, which comprises the tarsus, retractors, conjunctiva, and ligaments that attach the tarsus to the orbital rim [7].

The correct positioning of the lower eyelid relies on the balance between the inverting forces, which include the action of the orbicularis oculi muscle, and the everting forces, which ensure the tension of the lower eyelid retractors [8]. An imbalance between these factors can result in the development of entropion.

The primary factors contributing to involutional lower eyelid entropion are horizontal and vertical lower eyelid laxity, along with the migration of orbicularis oculi muscle fibers [9]. Accurate assessment of the presence of the factors mentioned above is essential for selecting the appropriate surgical method.

Additionally, involutional changes within the tarsal area, a positive orbital vector, increased fat volume in the fornices, and dermatochalasis with orbital fat herniations in the lower eyelid area predispose individuals to lower eyelid entropion [3, 9]. However, these factors play a lesser role in determining the operative technique.

Horizontal laxity – reduced tension of the lateral and/or medial palpebral ligaments leads to increased horizontal laxity of the lower eyelid. This mechanism is observed in approximately 80% of patients with lower eyelid entropion [9].

To determine whether horizontal laxity is present, the following are checked:

1. positioning of the lower lacrimal point while moving the lower eyelid laterally and parallel to the corneal surface, so that the degree of medial ligament relaxation can be assessed,
2. lower eyelid relaxation by pulling the eyelid away from the eye in the sagittal plane, known as the pinch test. The test is

considered positive if the eyelid can be pulled 8 mm or more from the surface of the eye,

3. the time it takes for the lower eyelid to return to its initial position after a maximum downward pull and release ('snap--back test'). This should be immediate, while horizontal laxity is indicated by a delayed return time or improper positioning of the eyelid [6, 9].

Vertical laxity – the weakening or disconnection of the lower eyelid retractors from the tarsus leads to the development of vertical laxity. To assess the occurrence and severity of vertical eyelid laxity, the lower eyelid should be gently pulled downward. If the eyelid retractors are weakened or disconnected, bulging fat pads may become visible in the lower fornix [9].

Migration of the orbicularis oculi muscle – the orbicularis oculi muscle is divided into two parts: the pretarsal part and the preseptal part. Each of these portions forms the superficial and deep layers of the medial and lateral palpebral ligaments [7]. Due to the weakened connection between the orbicularis oculi muscle fibers, the skin, and the tarsus, the preseptal fibers migrate upwards onto the pretarsal fibers [10]. This results in the muscle force primarily acting directly on the tarsus, causing the free eyelid margin to turn inward during strong eyelid contraction [8].

Orbital vector – a predisposition to lower eyelid entropion can be assessed by comparing the position of the eye relative to the orbit. A positive orbital vector is characterized by the inferior orbital rim being positioned anterior to the anterior surface of the cornea. This alignment is associated with a higher likelihood of lower eyelid entropion. Rajabi et al. demonstrated in their study that 87.5% of patients with entropion had a positive orbital vector [3].

Involutional changes in the tarsus – the tarsus is composed of collagen and elastic fibers which degenerate with age. This leads to the thinning and shortening of the tarsus, a decrease in the number of Meibomian glands, and increased laxity of the lower eyelid. The height of the tarsus decreases by approximately 50% with age, measuring around 5.28 mm in individuals under 50 and reducing to 2.3 mm in those over 60. The narrower tarsus, the greater the likelihood of lower eyelid entropion [9].

III. Surgical methods for treating involutional lower eyelid entropion

The goal of treating involutional lower eyelid entropion is to achieve lasting anatomical and functional correction, bearing in mind that the underlying involutional processes continue despite surgical intervention. A thorough preoperative assessment of the patient is essential to identify the causes of entropion, as the choice of surgical technique depends on the underlying mechanism of eyelid malposition [8].

Based on the primary factor contributing to lower lid entropion, surgical methods can be categorized as follows:

1. correction of horizontal eyelid laxity,
2. correction of vertical eyelid laxity,
3. prevention of the migration of orbicularis oculi fibers,
4. combined techniques [8, 9].

Re. 1. Horizontal eyelid laxity can be either generalized or localized to the medial or lateral palpebral ligaments. To strengthen the lower eyelid in the area of its greatest laxity, the following methods are used: lateral tarsal strip (LTS), wedge resection of the eyelid, plication or shortening of the lateral or medial ligament, or canthopexy [9, 11].

The LTS technique was first described in 1979 by Anderson and Gordy [12]. Currently, it is one of the fundamental methods in oculoplastic surgery, having replaced many other surgical approaches. It can be used alone or in combination with other surgical techniques [13].

The LTS method has been described in various studies as effective in correcting the malpositioned lower eyelid with accompanying laxity of the palpebral ligaments [7].

The LTS technique involves preparing a strip of the tarsus in the lateral part of the eyelid, shortening it to the appropriate length after performing a canthotomy and cantholysis, and then suturing the tarsal strip to the periosteum of the lateral orbital margin, 1–2 mm above the medial canthus [1].

Possible complications of this procedure include hypercorrection, conjunctival edema, pain and tension in the lateral canthus, eyelid hematoma, wound dehiscence, suture-related inflammation, conjunctivitis, granuloma formation, preseptal cellulitis, and retroseptal cellulitis [1, 11, 14]. However, the aforementioned complications are rare, and many specialists consider the LTS technique to be a safe, reliable, and effective treatment method [1].

Vydlakova et al. evaluated the effectiveness of the LTS technique in 20 eyes with entropion, including 17 eyes with involutional entropion. Correct postoperative eyelid positioning was achieved in 95% of cases [1]. Vahdani et al. analyzed a total of 209 eyelids treated with the LTS technique for entropion, of which 195 exhibited involutional changes. The researchers reported an anatomical success rate of 90.3% and a functional success rate of 87.6% [11]. In a separate study, Kadir et al. observed symptom recurrence in one out of 24 eyelids operated on using the LTS technique, which represents a recurrence rate of 4.2% [14]. Although LTS is widely regarded as a highly effective treatment modality for entropion, Lopez-Garcia et al. reported a recurrence rate of 17% (8 out of 46 operated eyes) after a follow-up period of 5.4 years [15].

The aforementioned statistics demonstrate that LTS is effective in correcting involutional lower eyelid entropion. While it addresses horizontal lower eyelid laxity, the most common factor contributing to entropion, it still results in a small percentage of recurrences. To improve the effectiveness of the procedure, the LTS technique can be combined with surgical methods targeting vertical laxity and orbicularis oculi fiber migration, which will be further discussed later in this article.

Alternative methods to LTS for correcting horizontal eyelid laxity include wedge resection of the eyelid and canthopexy [9].

Wedge resection of the eyelid can be successfully used as a standalone surgical method or in combination with other techniques. The advantage of wedge eyelid resection is a lower risk of infection in the surgical wound compared to the LTS method [9]. There are also several advantages of LTS over wedge resection of the eyelid. These benefits include, among others, superior cosmetic outcomes, preservation of the correct anatomy of the free eyelid margin, prevention of lid notching, avoidance of irritation to the eye from sutures, and faster recovery [11, 14].

Canthopexy involves strengthening the lateral ligament by plicating it and suturing to the periosteum of the orbital rim, without the need for a canthotomy. Canthopexy is the technique of choice for addressing mild horizontal lower eyelid laxity. An advantage of this approach is the prevention of the so-called 'round eye' appearance; however, a disadvantage is the potential recurrence of lower eyelid laxity [9].

Re. 2. Correction of vertical laxity of lower eyelid is accomplished by appropriately repositioning the lower eyelid retractors through folding, shortening, or the use of everting sutures (ES) [9].

The technique of **retractor plication** was first described in 1960 by Jones [16]. The procedure involves making an incision along the lower edge of the tarsus, cutting through the orbicularis oculi muscle, preparing the tissue up to the retractor layer, and suturing it to the lower edge of the tarsus.

Although not directly linked to the migration of the orbicularis oculi muscle, the incision of the anterior eyelid lamella creates a scar that acts as a barrier preventing the migration of the

orbicularis oculi muscle fibers [4, 16]. In addition, this method enables the removal of excess skin and fatty herniations [4]. Its use is associated with a recurrence rate of 3.4–11.5% [9, 17]. The most common complication associated with this type of surgery is eyelid ectropion, which occurs in 11% of cases [8, 9]. A limitation of this method is the presence of horizontal lower eyelid laxity, making it unsuitable as a stand-alone procedure for patients with lax palpebral ligaments [9].

The least invasive method for tightening the lower eyelid in the vertical plane is the use of **everting sutures**. These are mattress sutures placed in the inferior fold, passing through the full thickness of the lower eyelid. They function to tighten the retractors and evert the free eyelid margin [9, 18]. Due to fibroblast activity during the healing process, a scar forms along the sutures, acting as a barrier that prevents the fibers of the orbicularis oculi muscle from migrating upward to the pretarsal part. Advantages of this method include a short procedure time and the ability to use it in patients who are not candidates for more invasive surgery [6, 9]. Its main disadvantage is the high recurrence rate, which ranges from 7.2% to 33% [9]. The percentage increases to 49.3% when the lower eyelid with horizontal laxity is not surgically shortened [19]. The most common complications include granuloma and ectropion of the lower eyelid [5, 9].

Re. 3. To eliminate the migration of orbicularis oculi muscle fibers, techniques such as partial excision of the orbicularis oculi fibers, repositioning of a fragment of the muscle, or a full-thickness transverse eyelid incision can be employed. This creates a scar barrier that prevents further migration of the orbicularis oculi fibers. The last of the mentioned methods is combined with the use of everting sutures; however, a high recurrence rate is observed, ranging from 10.6% to 26%. The most common complication is eyelid ectropion, occurring in 10–31% of cases [9].

Re. 4. Combined techniques

A widely used technique for correcting involutional lower eyelid entropion is LTS. While effective, LTS primarily addresses horizontal eyelid laxity. Combining LTS with techniques that target vertical laxity and orbicularis oculi fiber migration can significantly reduce the recurrence rate in the treatment of involutional lower eyelid entropion.

LTS + retractor plication/ suturing

It has been demonstrated that combining the LTS technique with lower eyelid retractor plication is more effective compared to using the LTS method alone [13]. The figures illustrate our own results of involutional entropion treatment using the combined surgical method described above (Fig. 1–4).

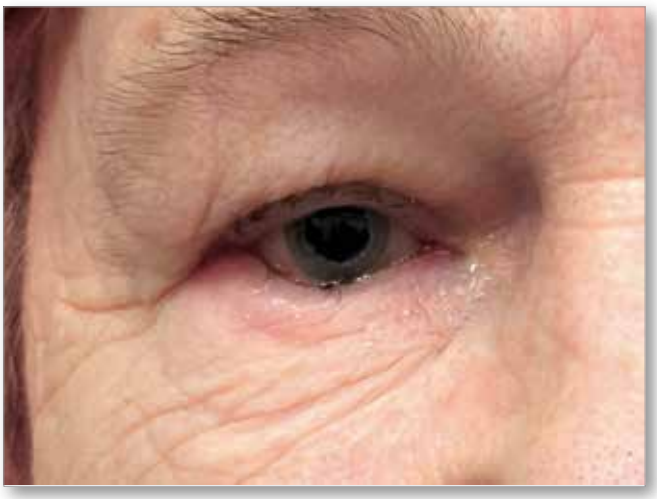

Fig. 1. Patient (83 years old) with involutional lower eyelid entropion.

Fig. 2. Patient (83 years old) 10 days after LTS + retractor plication procedure.

Fig. 3. Patient (80 years old) with involutional lower eyelid entropion.

Fig. 4. Patient (80 years old) 6 months after LTS + retractor plication procedure.

Ranno et al. compared the recurrence rate after retractor plication and the combined method (LTS + retractor plication) in 115 patients. In the former group, recurrence was observed in 16.5% of cases (10 out of 60 patients), while in the latter group, recurrence occurred in 3.5% of cases (2 out of 55 patients) during the 24-month follow-up. No serious complications were observed in either group [4]. Lee et al. compared the effectiveness of retractor suturing performed alone with the technique combined

with LTS. The standalone retractor suturing procedure was found to be effective in patients without diagnosed horizontal eyelid laxity. However, patients with horizontal eyelid laxity required a combined LTS procedure with retractor suturing. A 100% efficacy rate was achieved in patients treated with the appropriate surgical method. In contrast, when the procedure was limited to retractor tightening alone, a recurrence rate of 8.7% was observed in patients with horizontal eyelid laxity [20].

LTS + ES

Numerous authors have highlighted the efficacy of the LTS technique combined with concurrent ES. The combined method (LTS + ES) has been shown to be more effective than ES alone [13].

Scheepers et al. compared the outcomes of using ES alone with the combined technique (LTS + ES). The authors followed up a total of 55 patients for 18 months after surgery and observed no recurrence in individuals treated with the combined LTS + ES method (0/27 patients) compared to the 21% recurrence rate in patients treated with ES alone (6 of 29 patients) [5]. Rougraff et al. evaluated a total of 119 patients who underwent surgery for involutional entropion in 152 lower eyelids. After a 36-month follow-up, the recurrence rate was 1.6% for the combined LTS + ES procedure, 22% for LTS alone, and 33% for ES alone [21]. Ho et al. reported a recurrence rate of 9.4% following the LTS + ES technique two years post-surgery (3 out of 32 eyelids) [22]. Barnes et al. observed a 2% recurrence rate 12 months after surgery (1 out of 54 eyelids) [23], while Dulz et al. noted a 7% recurrence rate for entropion after 14 months of follow-up (2 out of 29 eyelids) [24]. Rabinovich et al. assessed the outcomes of the LTS + ES technique, with additional removal of a fragment of the hypertrophic orbicularis oculi muscle in affected patients. No recurrences were observed [25].

LTS + ES + retractor tightening

Serin et al. reported a recurrence rate of 2.2%, with a single recurrence in a group of 45 operated eyes, in patients who underwent the combined LTS + retractor tightening + ES [10].

A comparison of the effectiveness of selected surgical methods is presented in Table I (Tab. I).

IV. Conclusions

There are numerous surgical techniques available for the correction of entropion. When selecting the appropriate surgical method, the primary underlying cause of the symptoms is considered, which may include horizontal or vertical lower eyelid laxity or hyperactivity of the orbicularis oculi muscle [9]. The most common cause of involutional lower eyelid entropion is palpebral ligament laxity. The method of choice for correcting horizontal eyelid laxity is the LTS technique. While LTS alone yields good results,

Operative technique	Author	Number of eyelids at the end of the follow-up period	Follow-up time	Average patient age (years)	Number of recurrences	Recurrence rate
LTS	Vydlakova [1]	20	1 week	79	1	5%
	Kadir [14]	24	12 months	61	1	4.2%
	Lopez-Garcia [15]	46	5.4 years	nd.	8	17.4%
	Rougraff [21]	18	36 months	nd.	4	22%
Retractor suturing or plication	Park [17]	26	6 months	nd.	3	11.5%
	Lee [20]	46 (with horizontal laxity)	nd.	nd.	4	8.7%
		42 (without horizontal laxity)	nd.	nd.	0	0%
	Ranno [4]	60	24 months	75	10	16.5%
ES	Scheepers [5]	29	18 months	77	6	21%
	Rougraff [21]	9	36 months	nd.	3	33%
	Jang [19]	69 (with horizontal laxity)	24 months	nd.	34	49.3%
LTS + retractor plication or suturing	Lee [20]	47 (with horizontal laxity)	nd.	nd.	0	0%
	Ranno [4]	55	24 months	75	2	3.5%
LTS + ES	Ho [22]	32	24 months	77	3	9.4%
	Barnes [23]	54	18 months	77	1	2%
	Dulz [24]	29	14 months	65	2	7%
	Scheepers [5]	26	18 months	77	0	0%
	Rabinovich [25]	44	34 months	nd.	0	0%
	Rougraff [21]	125	36 months	nd.	2	1.6%
LTS + ES + retractor tightening	Serin [10]	45	22 months	nd.	1	2.2%

Tab. I. Comparison of selected surgical techniques for lower eyelid entropion in relation to the recurrence rate.

it is associated with a certain recurrence rate. Addressing only one factor (horizontal laxity) may be sufficient in some patients; however, numerous studies suggest that correcting both horizontal and vertical laxity is more effective in achieving eyelid stability and appears to provide a longer-lasting outcome [4, 5]. Based on the available literature, it can be concluded that combining the LTS technique with reinforcement of the retractors (either through plication or the use of everting sutures) represents a universal approach. This combined method is associated with the lowest recurrence rates and, consequently, the highest efficacy.

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