The zygomatic ligament of the face: a critical review

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Abstract
Introduction
The soft tissue of the face covers the underlying bony structures and is supported by ligaments that run from deep within the dermis to the overlying layers of the skin, serving as anchoring units for the face. The zygomatic ligament of the face is an osteocutaneous ligament that originates from the periosteum of the zygoma and/or the anterior and lateral border of the zygomatic arch (posterior to the origin of the zygomaticus minor muscle). It is found inserted into the superficial muscular aponeurotic system which is connected to the dermis of the cheek. This ligament restrains the facial skin against gravitational changes and delineates the anterior border of the cheeks. Attenuation of support from this ligament is responsible for many changes that occur during facial aging. The main application of this anatomical structure is in cosmetic surgery. The surgical correction of the retaining ligaments of the face, plication of the superficial muscular aponeurotic system and repositioning of the soft tissues of the face, are all common techniques used in the rejuvenation of the face. An overview of the literature regarding the location of the zygomatic ligament, its important relations and clinical applications are reviewed in this article.

Conclusion
The zygomatic ligament consists of the prezygomatic space, zygomatic branches of the facial nerve and the zygomatico-facial nerve. The main application of the zygomatic ligament is in cosmetic surgery. Further studies are necessary to establish relationships between the zygomatic ligament and variables such as age, sex, race and other such factors.

Introduction
The zygomatic ligament was initially described by McGregor in 1959. He described this anatomical structure in relation to his surgical techniques for facial rejuvenation during the Annual Meeting of the California Society of Plastic Surgeons in Yosemite, California. However, Mrs. Rosebud Preddy, a medical artist at the Letterman General Hospital in San Francisco, California, denominated the ligament as ‘McGregor’s patch’ when she prepared a slide presentation for Dr. Mar McGregor. This denomination has persisted since. McGregor described the ligament as, ‘An area of fibrous attachment between the anterior edge of the parotid fascia and the dermis of the skin of the cheek’. His facelift procedure did not recommend extension of the undermining skin beyond this patch. Plastic surgeons have mainly contributed in the study of the zygomatic ligament. Most of their publications are descriptive studies (outcome studies). The first good description of the anatomy of face ligaments was provided by Furnas in 1989. The zygomatic ligament was described as, ‘a bundle of white firm fibres, 3 mm in width and 0.5 mm in thickness, located 4.5 cm in front of the tragus’. He also described that ‘the ligament is 6 to 8 mm in length, travelling directly from the zygomatic bone to the dermis’. The article was limited in its analysis of the anatomical relations of the ligament and its histological description. He considered the face ligaments as a reminiscent of the retaining ligaments of the finger. It was found that these ligaments stabilise the skin of the fingers in order to allow better tactile function. Similar descriptions have been presented with regard to the tissues of the breast and feet. The concepts described by Furnas were further elucidated by Stuzin et al. in 1992. Stuzin et al. described the zygomatic and mandibular ligaments as being osteocutaneous (i.e. originating from the periosteum and inserting directly into the dermis). The other supporting ligaments are formed as a coalescence that occurs between the superficial and deep facial fascia in certain regions of the face, e.g. the masseteric ligament. Owsley and Kaye provided a brief description of the zygomatic ligament as, ‘a vertical septum between the masseteric fascia and SMAS’ and ‘an adherent area over the malar eminence’, during facelift procedures. The ligaments of the face have been classified by Moss et al. as true ligaments, septa and adhesions. The zygomatic and masseteric ligaments are considered as true ligaments. A true ligament is a discrete cylindrical arrangement of fibrous tissue that is surrounded by fatty tissue. Microscopic examination of these ligaments showed bands of dense connective tissue. These ligaments are known to arise from the deep fascia or periosteum and cross the sub superficial muscular aponeurotic system (SMAS) plane and the SMAS, where they divide into several branches which distribute the attachment of the ligament to the dermis. Rossell-Perry et al. conducted a recent study to understand the ligamentous attachments of the face and found both types of ligament structures for the masseteric ligament.
Figure 1: Location of the main retaining ligaments of the face.

Black arrow: entrance to the prezygomatic space.

Figure 2: The zygomatic ligament of the face and its relations.

Black arrow: entrance to the prezygomatic space.

Figure 3: The zygomatic ligament of the face and the prezygomatic space.

Black arrow: entrance to the prezygomatic space.

Discussion
The author has referenced some of its own studies in this review. These referenced studies have been conducted in accordance with the Declaration of Helsinki (1964) and the protocols of these studies have been approved by the relevant ethics committees related to the institution in which they were performed. All human subjects, in these referenced studies, gave informed consent to participate in these studies.

Descriptive anatomy
There are four main ligaments in the face: zygomatic, masseteric (or parotidomasseteric), mandibular and platysmaauricular2,5 (Figure 1). Other minor structures in the face are the preauricular parotid, SMAS malar and the anterior platysma cutaneous ligaments11. The soft tissue of the face is supported over the underlying bony structures by these ligaments that run from deep within the dermis to the overlying layers of the skin through the retinacula cutis, fixing facial structures and serving as anchoring units for the face. The retinacula cutis is a connective tissue composed of numerous small fibrous (true ligament and septa). Ozdemir et al.11 and Rohrich et al.12 conducted histological studies of the facial ligaments. The length of the ligament ranged from 7 mm to 10 mm between the skin and the zygoma and had significant collagenised connective tissue formation as described by histological examination. Rohrich et al.12 also described subcutaneous fat compartments in the face, limited by ‘septa’ originating from the underlying fascia and inserting into the dermis of the skin. Histological examination of the area between the nasolabial fold and the medial cheek showed a fibrous structure that inserts into the dermis of the skin. This structure is termed by these authors as the ‘middle cheek septum’. A good description of the location and relations of the zygomatic ligaments has been published by Mendelson et al.13-16. They described the prezygomatic space, an important area of the midface. This space is a junction area between the orbicularis retaining ligament (above), orbicularis oculi muscle and sub orbicularis oculi fat pad (anterior), the zygomatic ligaments (below), the zygoma and preperiosteal fat (posterior) and the lower temple (laterally). Recent studies about the zygomatic ligament have described its anatomy, functional characteristics and biomechanical properties17,18. Brandt et al.17 showed that the zygomatic ligament is the strongest and stiffest retaining structure in the face. In addition, they did not find any variations in the dimensions and biophysical properties of the ligament in relation with hemiface, age or sex. This critical review discusses the anatomy and the reconstructive applications of the zygomatic ligament.
strands that extend through the superficial fascia, attaching the deep surface of the dermis to the underlying deep fascia, determining the mobility of the skin over the deep structures. The zygomatic ligament, as described by Stuzin et al., is not a single structure. The original description of the 'McGregor patch' refers to the main component of these series of fibrous tissues that begin laterally where the zygomatic arch joins the body of the zygoma. This main structure extends through the malar fat pad and inserts into the overlying malar skin. An isolated structure originates along the most medial portion of the zygoma near the zygomaticomaxillary suture (Figure 2). These septa form an interconnecting framework that limits shearing forces on the face. This framework provides a 'retaining system' for the human face.

Superficial Anatomy
Furnas described the location of the zygomatic ligaments as being 4.5 cm in front of the tragus. In a recent publication, Rossell-Perry et al. found the location of the zygomatic ligament to be 4.3 cm to 5.5 cm in front of the tragus (average: 5.0 +/- 0.336). Ozdemir et al. found the location of the zygomatic ligament to be 4.2 cm to 4.8 cm in front of the tragus in men and 3.9 cm to 4.5 cm in women. This is less evident in younger people and more obvious in the elderly. The proximal insertion is usually not related to the age, as described by Furnas, and remains unchanged during the process of aging. Raksin et al. observed that the location of the zygomatic ligaments was mildly affected by age. The localisation of the zygomatic ligaments may vary depending on age (distal insertion only), sex, race and populations. There are no studies describing the anatomic variations of the zygomatic ligament for these variables.

Relations
The most important relations of the zygomatic ligaments are: 1) above, the prezygomatic space and the zygomaticofacial nerve, a branch of the maxillary division of the trigeminal nerve (Figures 3 and 4); 2) medially, buccal branch of the facial nerve to the orbicularis oculi muscle, the infraorbital nerve and the malar fat pad (Figure 2); 3) below, the upper zygomatic branch of the facial nerve, zygomatic muscles, transverse facial artery, parotid duct, Bichat's fat pad and masseteric ligaments (Figures 5, 6 and 7) and 4) laterally, the lower temple.

Function
The importance of the zygomatic ligament lies in its ability to suspend malar soft tissue over the zygomatic eminence. The ligament efficiency depends on the width of its attachments to the skin and if small, the...
Figure 7: Relations of the masseteric ligament.

Critical review

The zygomatic ligament is not a single structure. The original description of the ‘McGregor patch’ refers to the main component of these series of fibrous tissues that begin laterally where the zygomatic arch joins the body of the zygoma. The most important relations of this structure are the prezygomatic space, the zygomatic branches of the facial nerve and the zygomaticofacial nerve. The main application of these anatomical structures is in cosmetic surgeries (facelift). Further studies are recommended to improve our understanding of the relationship between the zygomatic ligament and variables such as age, sex, race or other such factors.

Abbreviations list
SMAS, superficial muscular aponeurotic system.

References
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