A Histologic Study of Retrodiscal Tissues of the Human Temporomandibular Joint in the Open and Closed Position

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Specialized roles for the different components of the retrodiscal tissues have been previously postulated. This study compared the histologic features of the retrodiscal tissues of temporomandibular joints, taken from human cadavers, in the open and closed position; it was concluded that the primary role of these components was to provide a volumetric compensatory mechanism for pressure equilibration. This mechanism was still active in joints that demonstrated disc displacement and degenerative changes. Elastin was found in the upper and lower strata of the retrodiscal tissues, as well as in the central zone. The concept of an elastic upper stratum that has a recoil mechanism to control disc movement was not supported by this study, as the upper stratum was folded on itself in the closed position and only became stretched near maximal opening.

J OROFACIAL PAIN 1994;8:7–17.

In trying to improve one's knowledge of temporomandibular joint (TMJ) dysfunction, it is important to understand the functional anatomy of the joint during movement. Methods that have been used to study movement of joint components are pantography, axiography, and computer simulation. These techniques do not give detailed information of the changes in the relationship of the disc, capsule, and retrodiscal tissues during joint movement, as they only record hard tissues. More recent techniques, such as fluoroscopy, arthrography, arthroscopy, computed tomography, and magnetic resonance imaging, have increased our knowledge of these relationships.

Rees[1] described the retrodiscal tissues as a "bilaminar zone" because of the loose, stretchable upper stratum containing elastin and the nonstretchable lower stratum containing relatively few elastin fibers. It was reported that, posteriorly, the upper and lower strata blended with the fibers of the posterior capsule that could be seen running from the temporal bone to the mandible. In a study of fresh human postmortem material, Rees observed that the retrodiscal tissues expanded to fill the glenoid fossae as it was vacated by the condyle on opening and suggested that venous engorgement of the retrodiscal tissues could facilitate these volume changes. Rees also recorded that the condyle moved 15 mm forward on full opening whereas the disc could only move 7 mm forward before it was restrained by the upper stratum. The remainder of forward condylar movement was achieved by the condyle then sliding along the undersurface of the disc. It was suggested that the return of the disc when the condyle moved backward was caused by its attachments to the condyle, and that this was aided by a mechanism of elastic recoil of the upper stratum of the retrodiscal tissues.

Findlay[2] measured the venous pressure in the posterior attachment area of the disc in human subjects during jaw movement and found that there was a transient decrease in pressure on opening and an initial increase in pressure on closing. Compensation for these pressure changes with time suggested that some passive venous mechanism was operating within the retrodiscal tissues.

Osborne[3] suggested that the retrodiscal tissues have neutral tension in the closed position and become stretched even at the midrange of opening. The recoil of the elastic retrodiscal tissues prevented entrapment of the neurovascular tissues on closing. Osborne expanded the concept that in the closed position a venous pool occupied the plexus medial to the condyle and that on opening, this pool moved posteriorly to the vessels of the plexus behind the condyle, which resulted in the balancing of tissue pressure.

Zenker[4] examined the histology of human cadaver TMJs and described the retrodiscal tissues as a "retroarticular plastic pad" consisting primarily of a richly vascular venous plexus. This investigator suggested that, as the condyle vacated the glenoid fossae on opening, the pad was expanded by venous engorgement to fill the potential space generated posteriorly. Zenker did not describe a posterior capsule but indicated that collagen fibers of the retroarticular pad connect with the squamotympanic and mandibular periosteum and reach into the parotid gland. Additionally, Zenker reported a specialized area of the upper and lower strata of the retrodiscal tissues close to the posterior band of the disc. In these areas there were many bays connected to the joint spaces that were considered to contain synovial fluid.

Scapino[5] examined human autopsy TMJs and studied the histopathology of the retrodiscal tissues associated with anteriorly displaced discs. This investigator reported that the retrodiscal tissues were capable of remodelling when subjected to compressive functional loading resulting in fibrosis and suggested that these changes allowed such joints to withstand loads applied during function.

In later studies, Scapino[6,7] further described the posterior attachment in a histologic study of 21 cadaver TMJ specimens prepared with the jaw closed or slightly open. Elastin fibers were seen in the temporal and condylar part of the posterior attachment. They were also seen in the intermediate part of the posterior attachment, where a venous plexus was supported by a trabeculae of connective tissue rich in elastin fibers. Scapino did not describe a posterior joint capsule but demonstrated collagen fibers running from the postglenoid process and auditory meatus to the periosteum of the condylar neck. It was suggested that the posterior attachment was capable of large volumetric fluctuations and appeared to function as a device for rearrangement of blood, tissue fluid, and synovial fluid. It was felt that the study methods did not allow observations of how the posterior attachment changed between the open and closed position.

These previous studies suggest specialized roles for the different components of the retrodiscal tissues but do not allow direct comparison of the changes in these components during function. The aim of the present study was to observe the histologic features of the retrodiscal tissues in the open and closed position.

Methods and Materials

Eight human cadaver TMJs were taken from subjects whose ages ranged from 63 to 85 years and where preservation was by infusion with formalin, phenol, glycerin, and ethanol. These joints were dissected to obtain a block of tissue bound anteriorly by the posterior wall of the maxilla, posteriorly by the external acoustic meatus, superiorly by the floor of the middle cranial fossae, and medially by the medial pterygoid plate. Care was taken to maintain the integrity of the lateral capsule during dissection. The block was then washed in running water for several days until the preserving fluid ceased to be evident.

The upper part of the temporal bone of the tissue block was dissected free and was encased in a plaster key. The ramus of the mandible was embedded in a separate plaster key (Fig 1). A perspex rod was inserted through drill holes in the upper and lower keys to hold the condyle in a protrusive position in the glenoid fossae (Fig 2). The block was then placed in decalcifying solution (Decalcifier II, Surgipath, IL). Once there was radiographic evidence of complete decalcification, the joint was cut into lateral and medial halves along a parasagittal plane at right angles to the long axis of the condyle. The blocks were again washed in running water for 24 hours.

The joint tissues maintained their protruded relationship during the dissection (Fig 3). The medial half was processed in paraffin to provide histologic sections of the joint in the open position. It was possible to manipulate the condyle of the lateral half of the joint into its centered position in

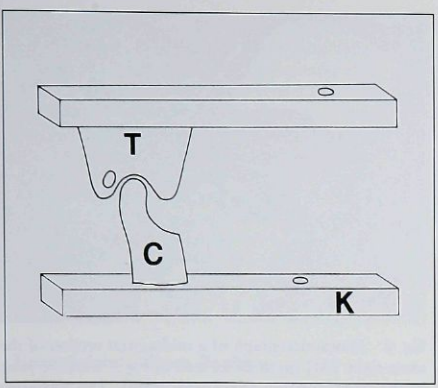


Fig 1 Temporal bone (T) and condyle (C) embedded in plaster keys (K) with the condyle seated in the glenoid fossae.

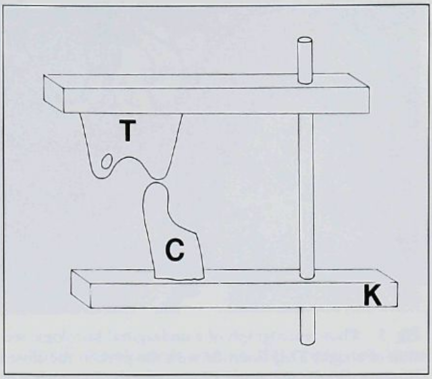


Fig 2 Temporal bone (T) and condyle (C) being maintained in a protruded relationship by a perspex rod through holes in the plaster keys (K).

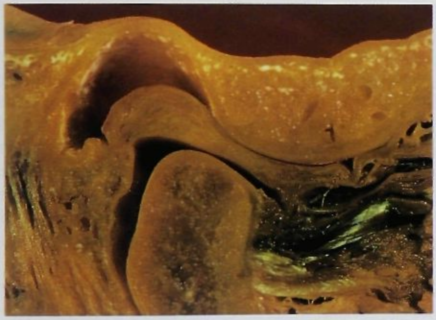


Fig 3 A midsagittal section through a right TMJ (joint A) that was decalcified while the condyle was held in protrusion. The retrodiscal tissues did not expand to fill the glenoid fossae due to the fixation of the cadaver material and the inflow of fluid during preparation.

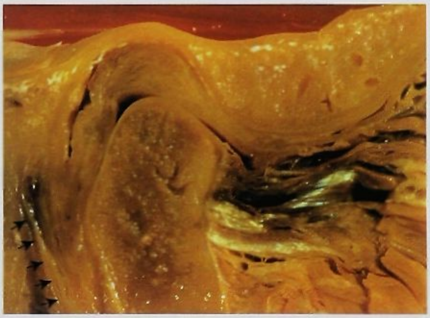


Fig 4 A midsagittal section through the same decalcified right TMJ (joint A) as in Fig 3 with the condyle manipulated into a seated position in the glenoid fossae. The retrodiscal tissues are drawn out and extend from their base at the posterior capsule (arrows) to their apex at the posterior band of the disc.

the glenoid fossae (Fig 4). This was then trimmed, boxed, and embedded in paraffin to provide histologic sections of the joint in the closed position.

Sections were cut to 7-μm thicknesses and stained selectively using Haematoxylon and Eosin, Verhoeffs, and Trichrome methods before being photographed (Figs 5 and 6). Line drawings were made of the condyle, temporal surface, disc, and retrodiscal tissues to estimate dimensional changes between the open and closed position. These were then redrawn to show the expanded retrodiscal tissues filling the glenoid fossae (see Fig 20).

Results

Histologic sections of the eight joints were examined in the open and closed positions. Five joints demonstrated essentially normal anatomy, there was an anteriorly displaced disc in one joint, and two joints showed degenerative changes.

Normal Joint—Closed Position

The retrodiscal tissues made up a rhomboid with the fibers of the posterior capsule forming a broad

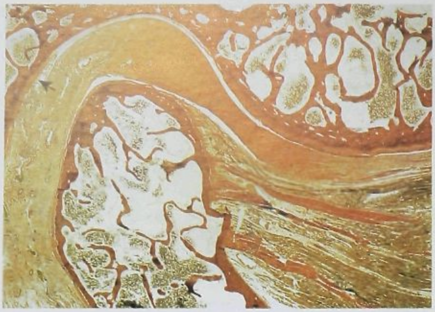
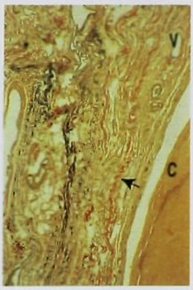


Fig 5 Photomicrograph of a midsagittal histologic section of a right TMJ (joint B) with the joint in the closed position (Verhoeffs stain) illustrating the narrowing of the retrodiscal tissues and the posterior part of the upper stratum folding on itself (arrow) (magnification ×2).

Fig 6 Photomicrograph of a midsagittal section of the same right TMJ (joint B) as seen in Fig 5 with the joint in the open position (Verhoeffs stain). The posterior border of the disc is positioned well down the posterior slope of the eminence and lies opposite the base of the retrodiscal tissues (magnification ×2).



Figs 7 and 8 *(Left)* Photomicrograph of a midsagittal histologic section of the same right TMJ (joint B) as seen in Fig 5 with the joint in the closed position illustrating the upper and lower fibroelastic strata and the central zone containing fibroelastic tissue and venous channels (Verhoeffs stain). The posterior part of the upper strata is folded on itself (arrow) whereas the lower stratum is drawn out (magnification ×4); *(right)* Photomicrograph at higher magnification of the inferior stratum of the retrodiscal tissues as seen in Fig 7 with the condyle seated in the closed position. This section illustrates the fibroelastic tissues (arrow) of the inferior stratum orientated parallel to the surface of the condyle (C). The central zone also shows dark staining elastin fibers and the venous channels (V) are drawn out parallel to the inferior stratum (magnification ×10).

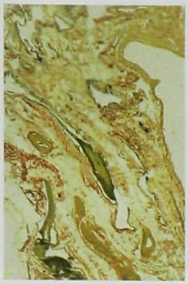
base, the upper and lower strata constituting the walls, and the posterior band of the disc forming the apex (Fig 3). These boundaries enclosed the central zone of the retrodiscal tissues that contained a branching system of fibroelastic tissue, collagen fibers, lymphatics, fat deposits, arteries, a large venous plexus, and an extensive nerve supply (Fig 7). Elastin fibers were seen in both the upper and lower strata and were loosely distributed throughout the central part of the retrodiscal tissues.

The upper stratum ran from the posterior part of the disc to the posterior slope of the glenoid fossae in front of the postglenoid process where it was folded on itself (Fig 7). It was made up of dense fibroelastic tissue that was mainly oriented parallel to the surface of the glenoid fossae.

With the condyle seated in the fossae, the central zone of the retrodiscal tissues was condensed and assumed a minimum volume. The large, thin-walled venous channels were collapsed and drawn out parallel to the upper and lower strata (Fig 7).

The lower stratum ran from the posterior part of the disc to attach well down on the condylar neck. This stratum was also made up of fibroelastic tissue with collagen fibers oriented parallel to the surface of the condyle (Fig 8).

The posterior capsule ran from the squamotympanic suture to the neck of the condyle below the attachment of the lower stratum and was made up of condensed fibrous tissue (see Figs 4 and 14). Parotid gland tissue was seen inferior to the posterior capsule.



Figs 9 and 10 *(Left)* Photomicrograph of the retrodiscal tissues as seen in Fig 6, at a higher magnification, with the joint in the open position. The venous plexus of the central zone is expanded and the fibroelastic network assumes a convoluted appearance (magnification ×4); *(right)* photomicrograph of the upper stratum of the retrodiscal tissues as seen in Fig 6, at higher magnification, with the condyle in the open position. The lumen of the blood vessels (arrows) are orientated mediolaterally in close relationship to the joint space. Elastin fibers are distributed throughout the central and upper strata (magnification ×10).

Normal Joint—Open Position

In vivo, the retrodiscal tissues expand to fill the space between the condyle and the glenoid fossae during opening. Because of the fixation of tissues and the fluid inflow to the joint spaces during the extended period of preparation, the retrodiscal tissues in the study specimens did not fill the glenoid fossae in the open position (Fig 3). However, they did show the expansion of the central zone and the potential for in vivo changes in the length of the upper and lower strata.

On opening, the upper stratum was drawn out, losing its posterior fold, and the lower stratum folded as the condyle translated forward. The loose supporting fibroelastic framework of the central zone allowed the blood vessels of the retrodiscal plexus to expand to compensate for the forward movement of the condyle (Figs 6 and 9). The increase in volume of the retrodiscal tissues was achieved by the lower stratum moving downward and forward away from the upper stratum (see Fig 20).

Considering the retrodiscal tissues as a rhomboid with a base on the posterior joint capsule and an apex at the posterior band of the disc, the structures of the central zone were stretched and narrowed in the closed position and expanded during opening. Potential in vivo changes were estimated from the line drawings, from which measurements showed the following relative changes during opening (see Fig 20):

1. The posterior capsule forming the base doubled in length.
2. The upper stratum increased in length by one quarter, losing its posterior fold.
3. The lower stratum remained relatively unchanged in length.
4. The volume of the retrodiscal tissues on opening increased by a factor of 4 to 5.

Small vessels were seen in the upper and lower strata in close relation to the joint spaces (Fig 10). They demonstrated a thin endothelial lining and some erythrocytes were present in their lumen. These small blood vessels were more noticeable close to the posterior band of the disc where their lumens were oriented mediolaterally.

Joint With Disc Displacement

In one joint, there was an anteriorly displaced disc in the closed position with the retrodiscal tissues drawn forwards over the crest of the condyle (Fig 11). The disc had a normal appearance being made up of condensed fibrous tissue (Fig 12). The foot of the disc was attached well forward of the anterior rim of the condyle and was positioned under the crest of the eminence. The condyle was seated in a concavity immediately behind the posterior band of the disc. The anterior one third of the retrodiscal tissues was compressed and showed a reduction in vascularity with the collagen and elastin fibers in the central zone oriented parallel to the surface of the upper and lower strata. The posterior two thirds of the retrodiscal tissues presented normal vascularity. There was a fold in the posterior part of the upper stratum close to its attachment to the postglenoid process.

On opening, the disc did not move in relation to the temporal surface, but the condyle moved forward to relocate under the central part of the disc (Fig 13). The condensed anterior one third of the retrodiscal tissues did not expand, and it assumed accordion-like folds (Fig 14). There was an increase in the distension of the venous channels in the posterior two thirds of the retrodiscal tissues and an increase in the upward bulging of the parotid gland and posterior capsule. The upper stratum did not increase in length and maintained its fold posteriorly.

Fig 11 Midsagittal section through a right TMJ (joint C) in the closed position showing an anteriorly displaced disc with the posterior band of the disc at the level of the anterior rim of the condyle. The condyle is seated into the compressed retrodiscal tissues behind the posterior band of the disc.

Fig 12 Midsagittal section through the same joint as seen in Fig 11 (joint C). In the open position the condyle has moved under the central part of the disc. The anterior one third of the retrodiscal tissues remains compressed while the posterior two thirds is expanded on its base over the posterior capsule and parotid gland.

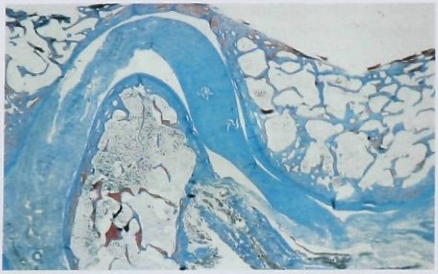


Fig 13 Photomicrograph of a midsagittal histologic section of the same right TMJ as seen in Fig 11, showing the displaced disc in the closed position (Trichrome stain). The condyle seats into the condensed, fibroelastic tissue of the anterior one third of the retrodiscal tissues (magnification ×2).

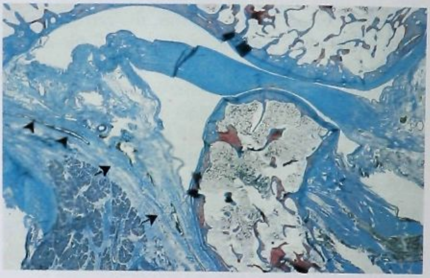


Fig 14 Photomicrograph of a midsagittal histologic section of the same right TMJ as seen in Fig 12, showing a displaced disc in the open position (Trichrome stain). The condyle is seated under the central part of the disc. The retrodiscal tissues anteriorly are condensed and folded on themselves. Posteriorly the retrodiscal tissues have a broad base on the posterior capsule that is bulged superiorly by the parotid gland (magnification ×2).

Degenerate Joints

Two joints showed marked remodelling and degenerative changes. In the less severely affected joint, the superior surface of the condyle was concave and the anterior rim formed a beak at the insertion of the lateral pterygoid muscle (Fig 15). The anterior two thirds of the elongated disc lay in front of the beak, and the thickened posterior third was adapted to the depression in the condylar head. The anterior two thirds of the retrodiscal tissues showed a reduction in vascularity and were compressed and thinned over the posterior slope of the condyle, where the retrodiscal tissues separated into three distinct strata (Fig 16). It was possible to differentiate the modified anterior part of the retrodiscal tissues from the disc because of the presence of elastin and blood vessels. The posterior two thirds of the retrodiscal tissues exhibited a normal appearance but with a reduced vascularity.

In the second joint, the articular surfaces of the condyle and temporal bone were flattened and had undergone complete degeneration (Figs 17 and 18). There was complete perforation of the disc, with the major discal remnant positioned inferior

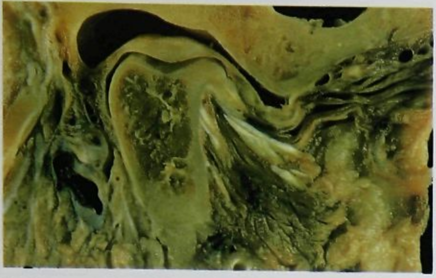


Fig 15 A midsagittal section through a right TMJ (joint F) showing degenerative and remodelling changes. The head of the condyle is concave with anterior beaking and the lower surface of the disc has adapted to the shape of the condyle. The retrodiscal tissues are shortened and compressed over the posterior convexity of the condyle .

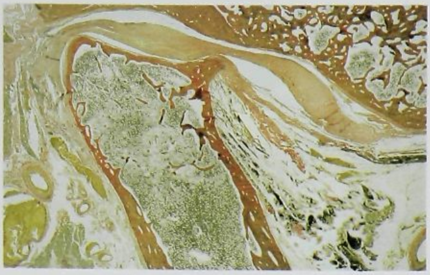


Fig 16 Photomicrograph of a midsagittal histologic section of the same right TMJ as seen in Fig 15 (Verhoeffs stain). There is fibrous remodelling of the anterior two thirds of the retrodiscal tissues that are interposed between the condyle and the roof of the glenoid fossae. The posterior one third of the retrodiscal tissues show more normal architecture but with a reduction in vascularity (magnification ×2).

to the anterior rim of the condyle. A narrow tongue of retrodiscal tissue remained posterior to the condyle, and in the closed position, it was seated in a crevice in the posterior part of the glenoid fossae. On opening, this tongue moved forward out of the crevice, and the blood vessels of the inferior two thirds of the retrodiscal tissues were seen to expand. Histologically, this joint showed extensive degenerative and remodelling changes in both articulating surfaces as cartilage metaplasia was occurring simultaneously with active resorption (Fig 19). The narrow tongue of retrodiscal tissue consisted of avascular fibroelastic tissue.

Discussion

Rees demonstrated in his cryosections of fresh postmortem material that the retrodiscal tissues expanded to fill the glenoid fossae during opening and that the upper and lower strata maintained close approximation to the joint surfaces. Over 30 years later, the technological advances of magnetic resonance imaging have allowed visualization of this expansion in the living individual.[6] In the present study, the retrodiscal tissues did not completely expand to fill the glenoid fossae in the open position because fixed cadaver material was being used and because there was slow ingress of fluid into upper and lower joint spaces during decalcification. Hence, the dissected joints and histologic preparations in this study did not reflect the in vivo situation. However, they still allowed us to visualize potential TMJ biomechanics on opening and closing.

In this study, the volume of the retrodiscal tissues was estimated to increase four to five times between the closed and open position (Fig 20). During mastication, the cycle of the condyle exiting and returning to the glenoid fossae may take less than 0.6 of a second. This high-speed ballistic movement is facilitated by smooth articular surfaces, the presence of synovial fluid, and highly coordinated muscle groups. As the condyle moves downward and forward on opening, there is the potential for a negative intracapsular pressure to develop. The condyle acts like a piston in a cylinder and its downward and forward movement could be hindered by the development of negative intracapsular pressure resulting in sluggish opening movement. The same circumstances would occur with a buildup of positive pressure on closing. To achieve rapid condylar movement during mastication, there must be a system to rapidly equilibrate the increase and decrease in intracapsular pressures.

Such compensation could be achieved by gas moving into the joint spaces during opening and being resorbed during closure. However, such reciprocal gaseous exchange would be unlikely to occur at the speed involved during mastication. A second alternative is that compensation could be achieved by extracapsular tissues bulging inward to compensate for the negative pressure generated during opening. This is reflected in the development of a depression in the skin in front of the

Fig 17 A parasagittal section through the medial third of a right TMJ (joint G) in the closed position showing extensive degenerative changes of the articulating surfaces. There is total perforation of the disc with a discal remnant anterior to the condyle and a small tongue of the retrodiscal tissues seated in a crevice in the posterior slope of the glenoid fossae (magnification ×2).

Fig 18 A parasagittal section through the medial third of the same joint as seen in Fig 17 in the open position. The fibrosed posterior remnant is clearly demonstrated above more normal retrodiscal tissues where the blood vessels of the central zone are expanded (arrows).

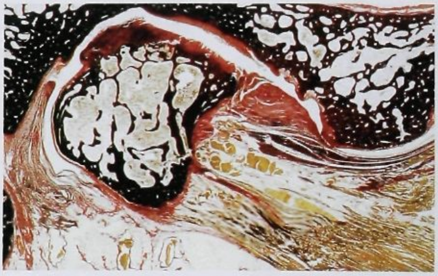


Fig 19 A photomicrograph of the same right TMJ as in Fig 18 (Verhoeffs stain). There is extensive degenerative change in both articulating surfaces with cartilage metaplasia. The anterior remnant of retrodiscal tissue is avascular and shows fibrosis (magnification ×2).

tragus of the ear as the condyle moves forward and the movement of parotid tissue into the glenoid fossae as seen in the open histologic sections. However, these changes are volumetrically insufficient to fill the space created by the condyle vacating the fossae. The third alternative, as suggested by Rees, is that compensation occurs by venous engorgement of the innately vascular retrodiscal tissues that are continuous with the pterygoid plexus medial to the condyle. On opening, this pool of venous blood may move posteriorly and laterally, expanding the retrodiscal tissues to fill the glenoid fossae as it is exited by the condyle.

The retrodiscal tissues can act as a compensatory balloon because of the expandable nature of the three-dimensional elastin framework of the central zone and its numerous venous channels. The rapid movement of the pool of blood is most likely to occur by passive redistribution of venous blood and not by a pressure gradient from the arterial system. The movement of the condyle tending to compress the medial plexus on opening and the retrodiscal tissues on closing facilitates the movement of the venous blood (Fig 21). Together with the compensation from air pressure and the inward movement of parotid tissue, the retrodiscal tissues provide a very rapid equilibration of intra-

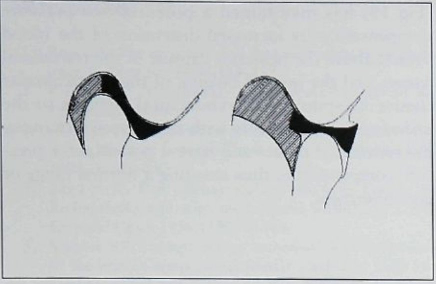


Fig 20 A diagrammatic representation of a line drawing of a sagittal section of a right TMJ showing the volumetric increase in the retrodiscal tissues between the open and closed position. On opening the disc translates forward to the crest of the eminence while rotating back on the head of the condyle. The superior stratum loses its posterior fold and increases in length by one quarter while the inferior stratum is unchanged in length, maintaining contact with the posterior part of the condyle and undersurface of the disc. The base of the retrodiscal tissues on the posterior capsule is bulged upward and doubles in length.

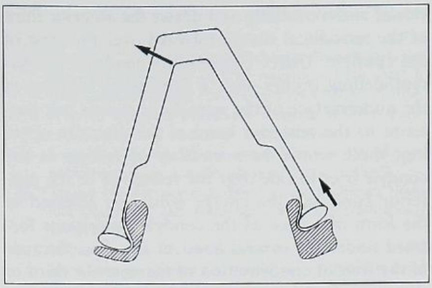


Fig 21 A diagrammatic representation of a superior view of the mandible during a left lateral movement. In the left TMJ, with the condyle seated in the fossae, the majority of the venous pool is anteromedial to the condyle. On the right side the condyle moves forward and medially, displacing the venous pool posteriorly into the expanding retrodiscal tissues.

capsular pressure that is essential to smooth joint movement.

It has been reported by several authors[1,9] that only the upper stratum contains elastin, and the hypothesis has been proposed[10] that the main function of the retrodiscal tissues is to provide an elastic mechanism to rotate the disc back on opening and to counter the forward pull of the superior head of the lateral pterygoid muscle on the disc on closing. The observation in cadaver preparations that the disc rotates back on opening and returns forward again on closing without active muscle control would suggest that the shape of the disc and its firm attachment to the medial and lateral poles are sufficient to achieve discal movement. Recent reports[11] that the superior head of the lateral pterygoid muscle has its main attachment to the condyle and is only active on final closure would suggest that disc movement is achieved passively without the need for fine balance between the upper stratum and the superior head of the lateral pterygoid muscle.

In this study, the posterior part of the upper stratum of the retrodiscal tissues was seen folded on itself in the closed position. This stratum unfolded on opening but only increased in length by one quarter by the time the condyle reached the crest of the eminence. This would suggest that the upper stratum exerts very little control over the disc except at maximum opening, at which point the main restraint to further forward movement of the condyle is most likely provided by the posterior capsule. The findings in this study that the upper stratum is folded on itself in the closed position and that this stratum is not unique in containing elastin would counter the hypothesis of an upper stratum recoil mechanism and reinforce the concept that the main function of the retrodiscal tissues is to act as a compensatory balloon.

Small channels on the surface of the upper and lower strata, close to the posterior band of the disc and adjacent to the joint spaces, were seen in all specimens in this study. Recent reports using arthroscopy[12] describe a fine network of surface vessels in the upper stratum adjacent to the posterior band of the disc that was considered as a sign of chronic irritation of the retrodiscal tissues. The findings from this present study and similar reports from Zenker[4] would suggest that these are normal structures that may be involved with the nutrition of the disc.

In anterior disc displacement, the disc is positioned anteromedially and draws the anterior third of the retrodiscal tissues forward over the crest of the condyle. Under compressive loading, fibrous remodelling occurs with a depression forming in the undersurface of the retrodiscal tissues just posterior to the posterior band of the disc. On opening, there would be a buildup of energy as the condyle tries to ride over the resistance of the posterior band and the energy would be released in the form of a click as the condyle repositions forward under the central band of the disc. Because of the fibrous condensation of the anterior third of the retrodiscal tissues, this area is unable to expand and contribute to pressure equilibration on opening. However, pressure compensation is still achieved if there is disc displacement through the increased distension of the venous channels in the posterior two thirds of the retrodiscal tissues and by the inward bulging of the extracapsular tissues.

Scapino[5] reported no increase in the thickness of the posterior band of the disc in joints showing disc displacement as had been suggested by other authors. Scapino suggested that failure of a displaced disc to reduce on opening was more related to the loss of the ability of the altered upper stratum to build up elastic tension than to the size of the restriction offered by a thickened posterior band of the disc. The findings in the present study that reduction of disc displacement can occur without change in length of the upper stratum would suggest that "recapture" of the displaced disc is related to factors other than elastic tension in the upper stratum.

Intermittent or complete anterior displacement without reduction may occur with deepening of the depression in the undersurface of the retrodiscal tissues behind the posterior band of the disc. This may occur early in the history of a displaced disc while the posterior band is of normal thickness and still offers resistance to the forward movement of the condyle. There may be a potential, through repositioning therapy, to encourage the condyle to relocate into the central part of the disc and for the compressed anterior one third of the retrodiscal tissues to return to a more normal shape, losing the concavity in its undersurface.

The two degenerative joints reflect the dynamic nature of the TMJ and the extensive potential for continued adaption to the functional demands throughout life. This is illustrated in the less severely affected joint (Fig 16) by the passive adaption of the disc and retrodiscal tissues to the remodelled condyle and temporal surfaces. The perforated joint (Fig 19) has maintained a potential for pressure compensation by increased distension of the blood vessels above the posterior capsule of the retrodiscal tissues and the inward bulging of the extracapsular tissues. Despite gross architectural changes to the articulating components with degenerative changes, the retrodiscal tissues still have a potential for pressure compensation, thus ensuring a normal range of jaw movement.

Conclusion

The histologic comparison of retrodiscal tissues in this study, representing the same joint in the open and closed position, improves our understanding of the special role of the elastin framework in the central zone where it supports a network of large venous channels. This framework ensures that these vessels can be rapidly filled or evacuated from the adjacent venous pool and hence provide the main pressure-compensating mechanism for the joint. Such a mechanism would be required in any joint where translation is a major part of its biomechanics. The movement of the condyle assists in relocating the venous pool.

Elastin was found in the upper and lower strata as well as in the central zone of the retrodiscal tissues. This finding is at variance with the observations of previous authors. The upper stratum was seen folded on itself in the closed position, indicating that it provides little control to disc movement during opening and closing. Findings in this study would suggest that the role of the retrodiscal tissues is not to act as a specialized disc recoil mechanism during condylar movement but to provide the primary volume compensatory mechanism for the joint.

In the case of anterior disc displacement, the development of a concavity in the inferior surface of the retrodiscal tissues, immediately behind the posterior band of the disc, severely interrupts smooth joint movement during opening and closing. This may lead to intermittent or complete locking with the condyle trapped behind the posterior band of the disc. Repositioning therapy may provide the possibility of reducing this concavity and restoring more normal joint movement. In joints showing degenerative changes, the remaining retrodiscal tissues are still able to provide pressure compensation, which ensures the potential for a normal range of jaw movement.

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Resumen

Estudio histológico de los tejidos localizados posteriormente al disco de la articulación temporomandibular humana en las posiciones de apertura y cierre.

Se han postulado previamente papeles especializados para los diferentes componentes de los tejidos localizados detrás del disco de la articulación temporomandibular (ATM). Este estudio comparó los rasgos histológicos de los tejidos localizados posteriormente al disco de las ATM, tomados de cadáveres humanos, en las posiciones de apertura y cierre. Se concluyó que el papel principal de estos componentes fue el de proveer un mecanismo compensatorio volumétrico para el equilibrio de la presión. Este mecanismo estaba todavía activo en las articulaciones que presentaban discos desplazados y cambios degenerativos. Se encontró elastina en los estratos superiores e inferiores de los tejidos localizados detrás del disco, así como en la zona central. Este estudió no soportó el concepto de un estrato superior elástico que tenga un mecanismo de retroceso para controlar el movimiento del disco, ya que el estrato superior estaba doblado sobre sí mismo en la posición de cierre y sólo se expandió cerca de la apertura máxima.

Zusammenfassung

Eine histologische Untersuchung des retrodiskalen Gewebes des menschlichen Kiefergelenkes in offener und geschlossener Position.

Bereits früher wurden spezialisierte Rollen für die verschiedenen Komponenten des retrodiskalen Gewebes postuliert. Diese Studie verglich die histologischen Eigenheiten des retrodiskalen Gewebes aus Kiefergelenken von menschlichen Leichen in offener und geschlossener Position. Man schloss, dass diese Gewebe zur Hauptsache eine Volumenkompensationsfunktion zum Ausgleich von Druckunterschieden haben. Dieser Mechanismus war auch in Kiefergelenken mit Diskusverlagerungen und degenerativen Veränderungen noch aktiv. In den oberen und tiefen Schichten des retrodiskalen Gewebes wurde Elastin gefunden, ebenso in der zentralen Zone. Das Konzept einer elastischen obersten Schicht zum Zurückziehen des Diskus konnte in dieser Untersuchung nicht unterstützt werden, zumal diese oberste Schicht in geschlossener Postition gefaltet erschien und sich erst nahe der maximalen Oeffnung ganz entfaltete.