

VI. *Of the Structure and Diseases of Articulating Cartilages*, by William Hunter, Surgeon.

Read June 2.
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THE Fabric of the Joints in the Human Body is a Subject so much the more entertaining, as it must strike every one that considers it attentively with an Idea of fine mechanical Composition. Where-ever the Motion of one Bone upon another is requisite, there we find an excellent Apparatus for rendering that Motion safe and free: We see, for Instance, the Extremity of one Bone moulded into an orbicular Cavity, to receive the Head of another, in order to afford it an extensive Play. Both are covered with a smooth elastic Crust, to prevent mutual Abrasion; connected with strong Ligaments, to prevent Dislocation; and inclosed in a Bag that contains a proper Fluid deposited there, for lubricating the Two contiguous Surfaces. So much in general.

But if Curiosity lead us a Step further, to examine the Peculiarities of each Articulation, we meet with a Variety of Composition calculated to all the Varieties of Motion requisite in the Human Body. Is the Motion to be free and extensive in one Place? There we find the whole Apparatus contrived accordingly. Ought it to be more confined in another? Here we find it happily limited. In short, as Nature's Intentions are various, her Workmanship is varied accordingly.

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These are obvious Reflections, and, perhaps, as old as the Inspection of dead Bodies. But modern Anatomists have gone further: They have brought the Articulations, as well as the other Parts of the Body, under a narrow Inquiry, and entered into the minutest Parts of their Composition. The Bones have been traced Fibre after Fibre; but the Cartilages, as far as I can learn, have not hitherto been sufficiently explained. After some fruitless Attempts by macerating and boiling the Cartilages in different *Menstrua*, I fell upon the Method not only of bringing their fibrous Texture to View, but of tracing the Direction and Arrangement of those Fibres. I shall therefore endeavour to give a short Account of the Structure of articulating Cartilages, and make a few Observations on their Diseases, with a View to advance a rational Explication of their morbid *Phænomena*.

An articulating Cartilage is an elastic Substance uniformly compact, of a white Colour, and somewhat diaphanous, having a smooth polished Surface covered with a Membrane; harder and more brittle than a Ligament, softer and more pliable than a Bone.

When an articulating Cartilage is well prepared, it feels soft, yields to the Touch, but restores itself to its former Equality of Surface when the Pressure is taken off. This Surface, when viewed through a Glass, appears like a Piece of Velvet. If we endeavour to peel the Cartilage off in *Lamellæ*, we find it impracticable; but, if we use a certain degree of Force, it separates from the Bone in small Parcels; and we never find the Edge of the remaining Part oblique, but always perpendicular to the subjacent Surface of the Bone. If we view this Edge through

a Glass, it appears like the Edge of Velvet; a Mass of short and nearly parallel Fibres rising from the Bone, and terminating at the external Surface of the Cartilage: And the Bone itself is planned out into small circular Dimples, where the little Bundles of the cartilaginous Fibres were fixed. Thus we may compare the Texture of a Cartilage to the Pile of Velvet, its Fibres rising up from the Bone, as the silky Threads of that rise from the woven Cloth or *Basis*. In both Substances the short Threads sink and bend in Waves upon being compressed; but, by the Power of Elasticity, recover their perpendicular Bearing, as soon as they are no longer subjected to a compressing Force. If another Comparison was necessary, we might instance the Flower of any corymbiferous Plant, where the *Flosculi* and *Stamina* represent the little Bundles of cartilaginous Fibres; and the *Calyx*, upon which they are planted, bears Analogy to the Bone.

Now these perpendicular Fibres make the greatest Part of the cartilaginous Substance; but without Doubt there are likewise transverse Fibrils which connect them, and make the Whole a solid Body, though these last are not easily seen, because being very tender, they are destroyed in preparing the Cartilage.

We are told by Anatomists, that Cartilages are covered with a Membrane named *Perichondrium*. If they mean the Cartilages of the Ribs, *Larynx*, Ear, &c. there, indeed, such a Membrane is very conspicuous; but the *Perichondrium* of the smooth articulating Cartilages is so fine, and firmly braced upon the Surface, that there is room to doubt whether

ther it has been often demonstrated, or rightly understood. This Membrane, however, I have raised in pretty large Pieces after macerating; and find it to be a Continuation of that fine, smooth Membrane that lines the capsular Ligament, folded over the End of the Bone from where that Ligament is inserted. On the Neck of the Bone, or between the Insertion of the Ligament, and Border of the Cartilage, it is very conspicuous, and may be pulled up with a Pair of Pincers; but where it covers the Cartilage, it coheres to it so closely, that it is not to be traced in the recent Subject without great Care and Delicacy. In this Particular it resembles that Membrane which is common to the Eye-lids and the Fore-part of the Eye-ball, and which is loosely connected with the *Albuginea*, but strongly attached to the *Cornea*.

From this Description it is plain, that every Joint is invested with a Membrane, which forms a complete Bag, and gives a Covering to every thing within the Articulation, in the same Manner as the *Peritoneum* invests not only the *Parietes*, but the Contents of the *Abdomen*.

The Blood-vessels are so small, that they do not admit the red Globules of the Blood; so that they remained in a great measure unknown, till the Art of filling the vascular System with a liquid Wax brought them to Light. Nor even by this Method are we able, in adult Subjects, to demonstrate the Vessels of the true cartilaginous Substance; the Fat, Glands, and Ligaments, shall be red with injected Vessels, while not one coloured Speck appears upon the Cartilage itself. In very young Subjects, after a subtle Injection, they are very obvious; and I have
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found their Course to be as follows: All round the Neck of the Bone there are a great Number of Arteries and Veins, which ramify into smaller Branches, and communicate with one another by frequent *Anastomoses*, like those of the Mesentery. This might be called the *Circulus Articuli Vasculosus*, the vascular Border of the Joint. The small Branches divide into still smaller ones upon the adjoining Surface, in their Progress towards the Centre of the Cartilage. We are very seldom able to trace them into its Substance, because they terminate abruptly at the Edge of the Cartilage, like the Vessels on the *Albuginea Oculi* when they come to the *Cornea*. The larger Vessels, which compose the vascular Circle, plunge in by a great Number of small Holes, and disperse themselves into Branches between the Cartilage and Bone. From these again there arises a Crop of small short Twigs, that shoot towards the outer Surface; and whether they serve for nourishing only, or if they pour out a dewy Fluid, I shall not pretend to determine. However that be, I cannot help observing, that the Distribution of the Blood-vessels to the articulating Cartilages is very peculiar, and seems calculated for obviating great Inconveniences. Had they run on the outer Surface, the Pressure and Motion of the Two Cartilages must infallibly have occasioned frequent Obstructions, Inflammations, &c. which would soon have rendered our Motions painful, and at last intirely deprived us of them. But by creeping round the cartilaginous Brim, where there is little Friction, or under the Cartilage, where there is none, they are perfectly well defended from such Accidents.

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It were to be wished we could trace the Nerves of Cartilages : But, in relation to these Organs, here, as in many other Parts of the Body, we are under a Necessity, from the Imperfection of our Senses, of being satisfied with mere Conjecture. And though, from the great Insensibility of a Cartilage, some have doubted of its being furnished with Nerves ; yet, as it is generally allowed, that these are a *sine qua non* in the Growth and Nourishment of Animals, we have no sufficient Reason to deny their Existence in this particular Part. With regard to the manner of their Distribution, we may presume, from Analogy, that they follow the same Course with the Blood-vessels.

The articulating Cartilages are most happily contrived to all Purposes of Motion in those Parts. By their uniform Surface, they move upon one another with Ease : By their soft, smooth, and slippery Surface, mutual Abrasion is prevented : By their Flexibility, the contiguous Surfaces are constantly adapted to each other, and the Friction diffused equally over the Whole : By their Elasticity, the Violence of any Shock, which may happen in running, jumping, &c. is broken and gradually spent ; which must have been extremely pernicious, if the hard Surfaces of Bones had been immediately contiguous. As the Course of the cartilaginous Fibres appears calculated chiefly for this last Advantage, to illustrate it, we need only reflect upon the soft undulatory Motion of Coaches, which Mechanics want to procure by Springs ; or upon the Difference betwixt riding a Chamber Horse and a real one. To conclude, the Insensibility of articulating Cartilages is wisely contrived, as by this means

means the necessary Motions of the Body are performed without Pain.

If we consult the standard Chirurgical Writers from *Hippocrates* down to the present Age, we shall find, that an ulcerated Cartilage is universally allowed to be a very troublesome Disease; that it admits of a Cure with more Difficulty than a carious Bone; and that, when destroyed, it is never recovered. *Hildanus*, in considering these Diseases, has observed, that when the Cartilages of a Joint were destroyed, the Bones commonly threw out a cementing *Callus*; and thus a bony *Anchylosis*, or immoveable Continuity, was formed where the moveable Joint had been. So far as I have had Opportunities of examining diseased Joints, either after Death or Amputation, I have found, according to the Nature and Stage of the Disease, the Cartilages in some Parts redish and lax; or soft and spongy; or raised up in Blisters from the Bone; or quite eroded, and, perhaps, the Extremities of the Bones carious; or, lastly, a bony *Anchylosis* formed. But I could never see, nor indeed hear of, the least Appearance of an Exfoliation from the Surface of the Cartilage. Now, if we compare the Texture and morbid *Phænomena* of those Cartilages together, all the diseased Appearances will admit of as rational a Solution, as perhaps any other Part of the vitiated Oeconomy.

It appears from Maceration, that the transverse Fibrils are extremely tender and dissoluble; and that the Cohesion of the Parts of the strait Fibres is stronger than their Cohesion with the Bone. When a Cartilage therefore is inflamed, and soaked in purulent Matter,

Matter, the transverse or connecting Fibres will the soonest give way, and the Cartilage becomes more or less red and soft, &c. If the Disorder goes on a little longer, the Cartilage does not throw off a Slough, but separates from the Bone, where the Force of Cohesion is least, and where the Disease soon arrives, by reason of the Thinness of the Cartilage. When the Bone is thus exposed, the Matter of the Ulcer, or Motion of the Joint, corrodes or abrades the bony Fibres. If the Constitution is good, these will shoot forth a *Callus*; which either cements the opposite Bones of the Articulation, or fills up the Cavity of the Joint, and for the future prevents Motion. But if, unfortunately, the Patient labours under a bad Habit of Body, the Malignancy, having got Root in the Bone, will daily gain ground, the *Carries* will spread, and at last the unhappy Person must submit to Extirpation, a doubtful Remedy, or wear out a painful, though probably a short Life.

Explication of the FIGURE.

- Figure 1. TAB. IV. *Represents a View of the Patella on the Backside, where it is covered with a smooth Cartilage. In this we may observe,*
- AAAA. *The Surface of the Cartilage, appearing, when the Perichondrium is removed, like Velvet. Near the Middle, Part of the Cartilage is taken out, in order to shew*
 - B. *The subjacent Surface of the Bone: And*
 - C. *The Thickness of the Cartilage, where the perpendicular Fibres are seen very distinctly.*
 - D. *The scabrous lower Point of this Bone, into which the Ligament is inserted that binds it to the Tibia.*

