Journal of Pain & Relief
ISSN: 2167-0846
Taylor, J Pain Relief 2022, 11:8
Mini Review
Open Access

Disc Replacement Study: The most Invasive Procedures

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Abstract

The cushioning and support of loads by the intervertebral discs are crucial to the longevity of vertebrae, and therefore, the nerves, since they run through the same joint separation.

Keywords: Therapy; Surgery; Treatment; Orthoses; Abdominal organs; Counselling

Introduction

However, because of the extensive movement that occurs in the cervical spine, the intervertebral discs go through drastic changes in stresses and strains causing them to be much more susceptible to injury, which can cause damage to or impingements on these nerves [1]. This can lead to feelings of weakness, numbness, tingling, and potentially loss of feeling.

The thoracic section of the spine consists of twelve vertebrae and twelve intervertebral discs, and extends from the bottom of the cervical spine to the beginning of the lumbar spine, supporting posture and stability throughout the trunk, and connection of the rib cage that houses and protects vital organs, such as the heart and lungs. This connection poses a significant decrease in mobility, as compared to the cervical spine section, and a greater stability and support of the entire trunk, usually leading to fewer cases of disc degeneration [2]. The vertebrae that make up the thoracic spine have body sizes that drastically increases descending, corresponding to an increased load bearing that is transferred from the vertebra above. All other features stay relatively the same throughout, except for the vertebrae, in which no ribs are connected. Along with this change towards the end of the thoracic spine, plays an interfacial role and has distinct thoracic characteristics superiorly and lumbar characteristics inferiorly for articulation with the vertebra, allowing rotational movements while disallowing movements. The thoracic spine contains nerves that are much less specialized per vertebrae like that of the cervical and lumbar spine, however they are no less important. The afferent and efferent nerves that stem from the spinal cord in this section power the muscles that lie around and between the ribs [3]. The sympathetic nervous system, which stems from the entire thoracic spine and top two lumbar vertebrae and help power the intercostal muscles, is necessary for vital involuntary functions such as increasing heart rate, increasing blood pressure, controlling breathing rate, regulating body temperature, air passage dilation, decreasing gastric secretions, bladder function, and sexual function. The thoracic spine and sacrum are the only sections of the spinal cord that these involuntary nervous systems stem from, and if impinged, can cause similar problems as discussed for the cervical spine. As mentioned previously, with these nerves passing through the same proximity as the intervertebral discs, cushioning of loads and proper weight dissipation is crucial for disc health and nerve protection, although the structural support of the ribcage makes damage to these discs much less prevalent [4].The lumbar section of the spine consists of five vertebrae and five intervertebral discs, and extends from the bottom of the thoracic spine to the beginning of the sacrum, which attaches the spine to the pelvis. This particular section of the spine needs to be the most resilient due to the vital functions it provides. Not only does it need to support all of the transferred weight from the previous spinal sections, but it also needs to be able to retain its mobility under these strenuous conditions. The lumbar spine, from bending over to standing straight, can go through more than a range for the average person. As well as bending motion, rotation becomes a big factor, with each normal lumbar segment having the ability to undergo up to rotation.

Discussion

When weight is added to these conditions, such as bending over to pick up a backpack or a weight from the floor, an immense amount of stress and strain is induced into the lumbar spine. Because of this, the vertebrae and intervertebral discs in the lumbar spine are the greatest in thickness, width, and depth. The vertebra starts out with a thickness, width, and depth greater than any of the cervical or thoracic vertebrae, and the trend only continues as the lumbar spine continues to descend to the vertebrae [5]. Although the vertebrae increase in size as the lumbar spine descends, none of the vertebrae themselves are specialized in any way like the aforementioned atlas and axis of the cervical spine. The vertebra is not much different to the others other than in size, but since it is the most inferior vertebra in the spine, it takes more load bearing responsibility than any other vertebra in the spine making it a necessity to be the biggest and strongest [6].

The lumbar spine contains afferent and efferent nerves that are much more similar to those of the cervical spine, in that each one that comes out of the different levels have very specialized functions, which if damaged, can hinder an individual's daily life and potentially leave them paralyzed from the waist down. These nerves control mainly the front of the lower extremities, and when impinged can lead to loss of feeling, mobility, weakness, isolated lower back pain, and extending leg pain [7]. With all of the load bearing, torsion, and bending, these nerves tend to have the most significant chance to be impinged or damaged, compared to any other spinal section. The sacrum consists of five fused vertebrae that connect to the pelvis at the sacro-iliac joint, and acts as the only skeletal connection between the trunk and the lower body. While in-adolescence, the sacrum remains un-fused, as an individual grows into adulthood, the sacrum begins to fuse together. The fusion

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Received: 25-Jul-2022, Manuscript No.JPAR-22-73023; **Editor assigned:** 27-Jul-2022, PreQC No. JPAR-22-73023 (PQ); **Reviewed:** 10-Aug-2022, QC No. JPAR-22-73023; **Revised:** 15-Aug-2022, Manuscript No. JPAR-22-73023 (R); **Published:** 22-Aug-2022, DOI: 10.4172/2167-0846.1000457

Citation: Taylor GM (2022) Disc Replacement Study: The most Invasive Procedures. J Pain Relief 11: 457.

of the sacrum tends to begin with the lateral elements fusing around puberty, and the vertebral bodies fusing at about 17 or 18 years of age, becoming fully fused by 23 years of age. The sacrum has few active roles in the body, however one of those roles are incredibly vital, being the bridge between the hips with the rest of the spine. Although the sacrum has no intervertebral discs, it does have very important afferent and efferent nerves that stem from the spinal cord, going through the entire lower extremity. The most important and commonly injured of these nerves travels through the space, which is more commonly known as the sciatic nerve. When this nerve is damaged or impinged it leads to pain and numbness down the legs hindering much of an individual's way of life.

The coccyx consists of three to five fused vertebrae depending on the individual that are connected to the bottom of the sacrum, and is usually referred to as the tail bone, and muscles, mainly those of which make up the pelvic floor, and supporting and stabilizing the body while in a sitting position [8].

The coccyx has no intervertebral discs nor do any nerves pass through it, therefore it is insignificant with regards to disc degeneration and disc damage. Every vertebra in the cervical, thoracic, and lumbar spines is separated by intervertebral discs, each named for the two vertebrae they sit between. These discs make up of the total length of the spine, and have incredibly important functions including load cushioning, reducing stress caused by impact, weight dispersion, allowing for movement of individual vertebrae, and allowing for the passage of nutrients and fluid to the spine and spinal cord. Although each disc grants almost identical functions to the spine, based on their location, their structure and mechanical properties change to adapt to the different loads, stresses, and strains produced. For example, as the expected weight-bearing role of each disc increases, descending from the base of the skull along the length of the spine, the transverse cross-sectional area of the discs also increases [9].

The pressure exerted on the discs however, does not increase to the same extent due to the fact that thecross-sectional area increases in the inferior direction.

Along with the changes in the cross-sectional areas of the discs, the height of each discchanges throughout the spine as well. The cervical and lumbar spines have been shown to have much thicker discs than that of the thoracic spine, most likely being adapted to the higher range of motion expected from these sections, for both flexion-extension and torsion. All cross-sectional areas and thicknesses for the continuation of this review will be associated with the transverse plane and disc height, respectively. On a smaller scale, the three components that form the disc, the annulus fibrosus, the nucleus pulposus, and the vertebral endplates, change throughout the spinal sections as well. For example, as the discs increase in thickness, the length of reinforcing fibers of the annulus fibrosus increase as well. This change allows for a decrease in fiber strain caused by a given movement for thicker discs compared to thinner discs. Although there is a general trend between the structural and mechanical properties of the intervertebral discs and the spinal sections they belong to, each individual disc of the same section have their differences.

In adults, the maximum flexion and extension of the cervical spine occurs around the disc, therefore its thickness is representative of such and will be, on average, thicker than the others. The cervical discs also show a maximum thickness in the anterior section and a minimum height in the posterior section, giving it a natural convex curvature [10]. Because of the mobility of the cervical spine, its discs have a significantly higher risk of damage from bending and torsion, making it the second most common spinal section for disc injury. Although the thoracic discs are greater in cross-sectional area than the cervical discs, they are still thinner in comparison. This is because the thoracic spine does not go through as much flexion/extension and rotation as the other sections of the spine, mainly due to the attachment of the rib cage.

Conclusion

The majority of the thoracic discs also show a greater height in the anterior section as opposed to the posterior section, like that of the cervical discs, however, the difference is not to the same extent as the other sections of the spine.

Acknowledgement

None

Conflict of Interest

None

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