IBN'I SINA INSTRUMENTATION PROJECT

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ABSTRACT :

A new spinal instrumentation is described briefly. The system is basically made up of : rod, hooks, transpedicular screws sublaminer wires, Rod-screw connectors, horizontal connectors, rod-rod connecting pieces. This system depends both on derotation maneuver and translational corrective forces and can be applicable both as anterior and posterior instrumentation.

Key Words : *Spinal Instrument, Ibn(i Sina Instrumentation.*

Spinal deformations, their correction and stabilization of the spine depend on certain mechanical rules. These principals are important on implant design, testing of the systems, clinical application, and evaluation of the insufficiency.

The spine is a column. Since the Euler period the mechanic of the column has been modeled. The human spine, made up of soft tissue and bones, and discs is a partially unstable column with its proximal and distal. But in the invivo dimension the column concept is still accepted.

Corrections on the Column:

There are two basic methods:

1. Axial Load,
2. Transverse Traction.

With the axial load method you can support a column, lengthen a short column or you can try to correct a bended column.

With the transverse traction method you can apply a certain force to the center of a bended column, like the one in figure 2. With this application the column is forced for correction not for lengthening.

Momentum: Is the multiplication of the force, and the perpendicular distance to the movement axis. The corrective action arises with this momentum. Its necessary to increase either the force or the moment arm. Increasing of the force is limited by the resistance of the bone's material. So its better and less risky to increase the moment arm.

In figure 1A and 1B the moment arm decreases with correction. That means as the Cobb angle decreases, you need to increase the force to correct a little bit more. In opposite to that, in transverse corrections as in figure 2, the moment arm is the distance ac or bc and it does not change. Which means the force and the Cobb angle are independent.

According to previous research; on a 90 degree curve, when distraction is applied on the concave side %70 of the force is effective on the column, on a 45 degree curve %35 of the force is effective on the columns correction. The understanding of this change lies under the term "effective momentum". The upperlimit of the distraction force is determined by the bones resistance to metal.

With the transverse corrective forces the "three point logic" is used. The moment arm does not change with angle correction. In curves with small angles it is more effective than distraction.

In correcting spinal column curves the most effective and logical thing to do is to use, to combine the transversal and axial forces together.

The rotational effects of axial corrections are nearly zero. With the transverse traction from the concave they lead to derotation. But their effects are low. Also Enneking has proved that the sagital length of the arm is smaller on the concave side than the convex side. This is one of the reasons for rotation.

Distraction Instrumentations:

Harrington, Jacob's rod, Zielke, Kostuik, Milwaukee brace are some. These systems are more effective over 53 degrees. These systems have some disadvantages. As the curve is straightened the need for more

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distraction may lead to insufficiency on the surface of the metal-bone.

It is hard to obtain the sagital curvature with the axial forces. Also it has been shown that the effect of the Harrington distraction drops to zero on a patient lying down, face up, for 2 weeks (Nachemson).

Distraction should never be used on a column that has lost its ligaments.

Compression Instrumentations:

They are corrective from the convex side to all types of curves. Weiss bow, Harrington compression system, internal-external fixers, Dwyer and Zielke are some.

Transverse Instrumentations:

The three point logic exists. Segmental traction is applied. Sublaminar hands, Steffee, Luque, Roy-Camille, dynamic plates are examples. These are really effective on short deformations. And they are also effective on correction of the sagital contour.

Combined Instrumentations:

Is the use of axial and transverse forces. They are very effective. Examples: CD, Zielke, Segmental wires, Harrington and Isola.

Fixation Elements:

- **Wires:** Monoflamant wires made of stainless steel with a diameter of 1.2 mm are known to carry force to approximately 75 kg of lamina.
- **Screws:** Are the primary fixation elements. Deeper and wider screws are more resistible against "pull out". It is an advantage for it to hold the anterior cortex from this point of view. The screw that fills the smallest diameter of the arm (pedicule) exactly is the strongest screw. Connections between the rods also make it harder for "pull out".
- **Rod Connectors:** 1. Rotational stabilization increases. 2. Though very small, axial resistance increases. Slope resistance to the lateral also increases.
- **Pelvic Fixation:** Axial systems are weaker than segmental connectors.

Relationship of Bone Implant

Waugh has shown that the weakest spot of axial distraction for the laminar hook is the lamina. The lamina can not resist over 44 lb. (20 kg). This tension can fix %60-70 of a flexible curve. On distractions over 30 kg the upper hook comes out. The capacity of a single wire is 850 N (190 lb.). Approximately at 100 kg the lamina tears apart.

The screw is taken out at approximately 45 kg (98 lb.). When the wire and the hook is compared the response of the lamina is nearly the same.

In the Universal Ibn'i Sina Instrumentation, the combination of transverse and axial forces are used. The system is basically made up of;

- Rod
- Hooks
- Transpedicular Screws
- Sublaminar Wires
- Rod-Screw Connectors
- Horizontal Connector between Rods
- Rod-Rod Extension Connector
- Anterior Plates
- Anterior Set
- Internal Fixer.

Procedure:

1. The upper limit of the fusion is determined.
2. The lower limit of the fusion is determined.
3. If possible, with the helf of CT the bottom neutral vertebrate is found. In the stabilized zone, the bottom vertebrate (s) having AP and sagital balance must be determined. The nearest vertebrate with this specification to the curve is the lowest one.
4. Concave side is primary.
5. The proximal laminar hooks and the transverse hooks are placed.
6. The vertebral screws are placed in the distal (min. 2). If not possible the lamino-laminar claw is prepared.
7. The rod with physical contours is prepared.
8. Sufficient amount of sublaminar connective wires are placed.
9. The rod is connected to the hooks.
10. Hook stabilization is obtained by the hook connector.
11. Sublaminar wires are tied to the rod.
12. Derotation is applied to the rod.
13. Sagittal tightenings are made (according to the contour).

14. Proximal and distal claws are put on the convex side.

15. Distal distraction and connections are also completed.

16. Proximal and distal claws are put on the convex side.

17. Compression is made on the convex side.

18. Distraction is remade on the concave side.

19. One couple of transverse connectors is used between rods.

20. Decortication and Grafting is finished.

With this operation the toracal curve is moved to Th7, which is a big advantage.

Even if the apex is Th12, after the derotation it is moved to Th7. After this transverse traction if necessary distraction can be applied with laminar hooks and screws with no loosenings in the system. These are major advantages of the system. The risk of iatrogenic laminolectomy on a rigid curve is nearly zero with this system.

In this mentality servical application is possible. The only disadvantage of the system is the insufficiency of the subliminar wires on axial forcing. This disadvantage is covered by the lamino-transverse or the lamino-lamina claws in the proximal and distal.

A short summary of the advantages of this posterior act is;

- There is derotation, but low.
- The risk of laminolectomy is lowered, and more corrective forces can be applied.
- After the derotation, adjustments can be made on the sagittal plan.
- It is the most effective way to correct curves on the Lordoz scale.
- With this method compression, distraction and translocation can be made on two adjacent vertebrates.
- It gives way to anterior application.

How this Method Looks at Transpedicular Effort:

The localization of the consecutive screws on the transverse plane and the differences in angles of the screws on the sagittal plane should be compensated, interior tension should not exist between rods and screws. The Ibn'i Sina connectors have solved this problem.

The rod-screw distance on the transverse plane errors in the Isola connectors have been compensated but the transpedicular screws on the sagittal plane should be parallel. In Ibn'i Sina's method there is independency in the angles of these screws.

In the Ibn'i Sina Instrumentation Project the intraoperative complications have been minimized.