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Effect of flexibility and implant density on curve correction in adolescent idiopathic scoliosis

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Abstract
Type of study: Retrospective study
Objectives: To evaluate correlation between flexibility, implant density on curve correction in adolescent idiopathic scoliosis
Materials and methods: We retrospectively reviewed all consecutive patients of adolescent idiopathic scoliosis who underwent single stage posterior-only correction and instrumented spinal fusion at a single centre between 2013 and 2015 performed by single surgeon. All cases of adolescent idiopathic scoliosis treated with all pedicle screw instrumentation were included. A total of 30 patients were studied, which included 20 females and 10 males. Correlation between implant density, flexibility and curve correction was investigated with pearson correlation coefficient.
Results: Average flexibility was 41.86%. Average implant density for rigid curves was 54.49%, flexible curves was 58%. Average curve correction for rigid curve was 60.22%, flexible curves79.56%.The correlation coefficient for curve correction and implant density was 0.096 for flexible curves, 0.075 for rigid curves, both were statistically not significant. The correlation coefficient for flexibility and curve correction was 0.578 for flexible curves and 0.506 for rigid curves which was statistically significant for rigid curves.
Conclusion: There was minimal positive correlation correlation between implant density and curve correctability in both flexible and rigid curves not statistically significant. There is positive correlation between flexixibility & curve correctability in both flexible and rigid curves which is significant in rigid curves.

Keywords: Implant density; Flexibility; Curve correctability

1. Introduction
Pedicle screws, using the strongest part of the vertebra as an anchor and 3-column fixation, helps in achieving 3dimensional deformity correction. Potential benefits include less long-term loss of correction, shorter fusions resulting in preservation of motion segments, lower pseudarthrosis rates, higher pull out strength, lower implant failures, and decreased risk of neurologic complications compared with these alternative posterior instrumentation systems [1]. Pedicle instrumentation has some consequences including radiation exposure, and a greater incidence of junctional kyphosis. With the pedicle screws, the cost of scoliosis surgery has increased because of high implant expenses. Decreasing the number of implants used may lower the surgical cost.
Biomechanical data simulating curve correction with variable implant density suggest that a minimum density screw pattern may result in a comparable correction as found with a high-density construct [2, 3].
We conducted the present study to assess. The effect of implant density & flexibility on curve correction in adolescent idiopathic scoliosis.

2. Materials & Methods
We retrospectively reviewed all consecutive patients of adolescent idiopathic scoliosis who underwent single stage posterior-only correction and instrumented spinal fusion at a single center between 2013 and 2015 performed by a single surgeon.

We have selected only cases of adolescent idiopathic scoliosis treated with all pedicle screw instrumentation. Other types of scoliosis and the surgeries in which other implants used (hooks, sublaminar wires) were excluded from study. A total of 30 patients were studied, which included 20 females and 10 males.

Preoperative T1 to S1 standing anterposterior, traction anteroposterior & lateral views taken. The curve is classified as per lenke's classification. The measurements of Cobb's angle are made by surgimap spine software. Flexibility of curve calculated based on standing & traction anteroposterior Cobb's angle. Based on flexibility the curves are subclassified into flexible & rigid. Flexible curves have flexibility greater than 50%, rigid curves have flexibility less than 50%. Post operatively the Cobb's angle measured with surgimap spine software. Curve correction rate is measured.

Implant density calculated in post op radiographs

Curve flexibility: [4, 5]

Standing cobb-traction cobb/standing Cobb X 100

Curve correctability: [4, 5]

Pre op cobb-post op cobb/pre op Cobb X 100

Implant density

No. of implants/ no. of available sites X 100

Surgical technique

All surgeries were performed by the same surgeon, the senior author, at a single institution using an identical surgical technique as described below. The primary aim of the surgery was to obtain a solid fusion and a balanced spine in the coronal and sagittal planes in all patients. The levels of fusion determined by the central sacral vertical line & proximal end neutral vertebra. Patients were placed prone over bolsters. The posterior elements of the predecided fusion levels of the spine were exposed by subperiosteal paraspinal muscle stripping. Most of the pedicle screws were monoaxial (fixed head) and inserted using a free-hand technique. After pedicle screw placement, intraosseous location was confirmed with intraoperative image intensifier coronal and sagittal radiographs. Distal fixation comprised 6 -7 mm diameter pedicle screws in the lower thoracic and upper lumbar spine. Apical fixation was usually with a pedicle screw on the convex & concave side. Following screw insertion, two 5.5-mm diameter titanium rods pre-contoured manually with a rod bender to mimic the normal sagittal contour were inserted either on concave or convex side first. Correction of the deformity was performed by a combination of rod derotation and convex compression and concave distraction. Thoracoplasty was done depending on the size of the rib hump. cross-links were generally used. The posterior elements were decorticated and bone grafts placed on the decorticated bed along the length of the instrumentation, which were a combination of autografts from the decorticated posterior elements and rib ends, if thoracoplasty was performed.

Curve correctability, flexibility, implant density calculated from pre and post op x rays. Correlation between implant density, flexibility and curve correctability evaluated with pearson correlation coefficient.

3. Results and discussion

There are 30 patients included in study out of which 20 females 10males. Average age of patient was 17.03yrs. There were 22 type 1 pts, 3 type 3 pts, 5 type 5 patients. There were 30 patients with 33 curves

Before surgery, the mean deformity in the coronal plane as measured by Cobb angle on standing radiographs was 61.90° (range: 21°–130°). Mean Cobb's angle on traction radiographs was 33.88% (range 15-75).Mean flexibility of the curve was 41.86% (range: 10.5%–68.8%), based on traction films. The mean number of vertebrae in the fusion was 10.2 (range: 8–13). The mean curve correction rate was 69.89% (30%- 97%). Mean Curve correction rate of rigid curves is 60.22% (30-78%). The mean curve correction rate of flexible curves is 79.56% (66-97%) The mean pedicle screw density per patient was 56.25% (41-83%). Rigid curve implant density was 54.49% (41-83%). mean implant density of flexible curve is 58% (46-80%). No misplacement of any pedicle screw was noted on intraoperative anteroposterior and lateral image intensifier radiographs or postoperative radiographs, and there were no screw-related adverse clinical consequences.

We have evaluated correlation between flexibility and implant density on curve correction.

For rigid curves there is a positive correlation between flexibility and curve correction which was significant (p-0.01) (figure 1). For rigid curves there is minmal positive correlation between implant density and curve correction (with correlation coefficient of 0.07) which is not statisticaly significant (0.732) (figure 2).

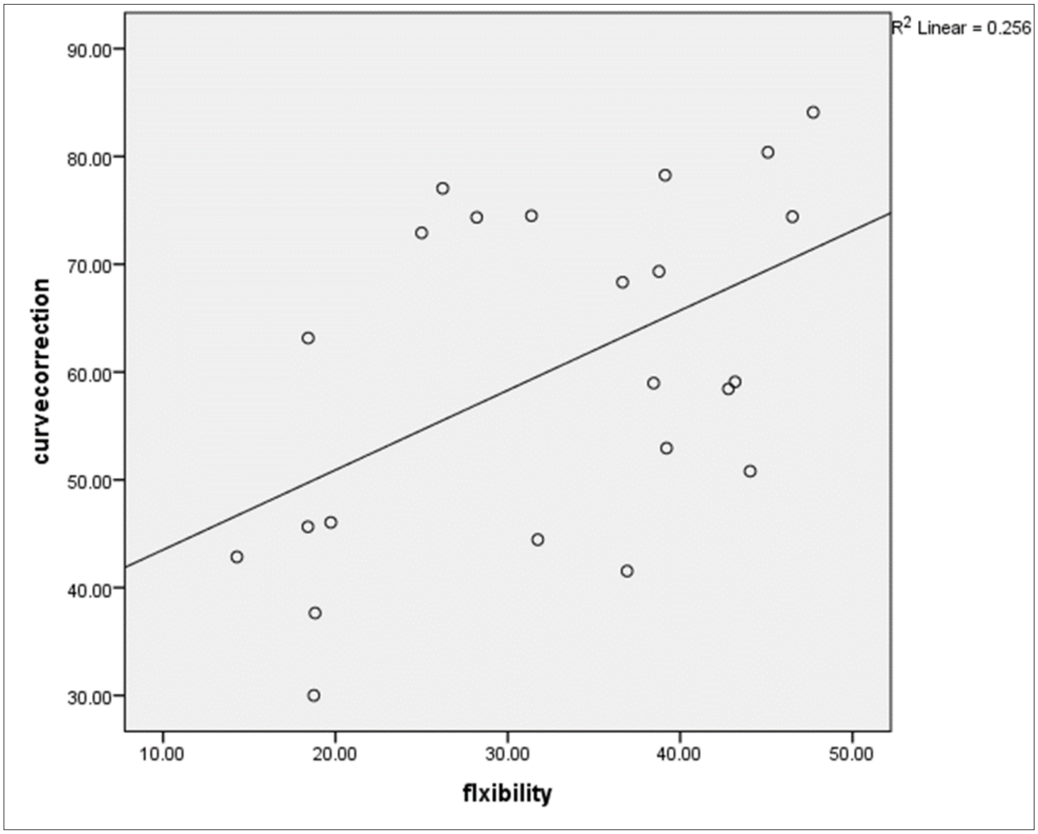
For flexible curves there is a positive correlation between flexibility and curve correction which was not significant (p-0.08) (figure 3). For flexible curves there is minimal positive correlation between implant density and curve correction (with correlation coefficient of 0.09) but it is not statisticaly significant (0.732) (figure 4).

4. Discussion

Extent of curve correction is not only dependent on surgical experience and technique and choice of instrumentation, but also on the inherent stiffness of the deformity. When analyzing whether implant density was associated with improved scoliosis correction, we have taken into consideration the flexibility of the deformity based on preoperative traction radiographs.

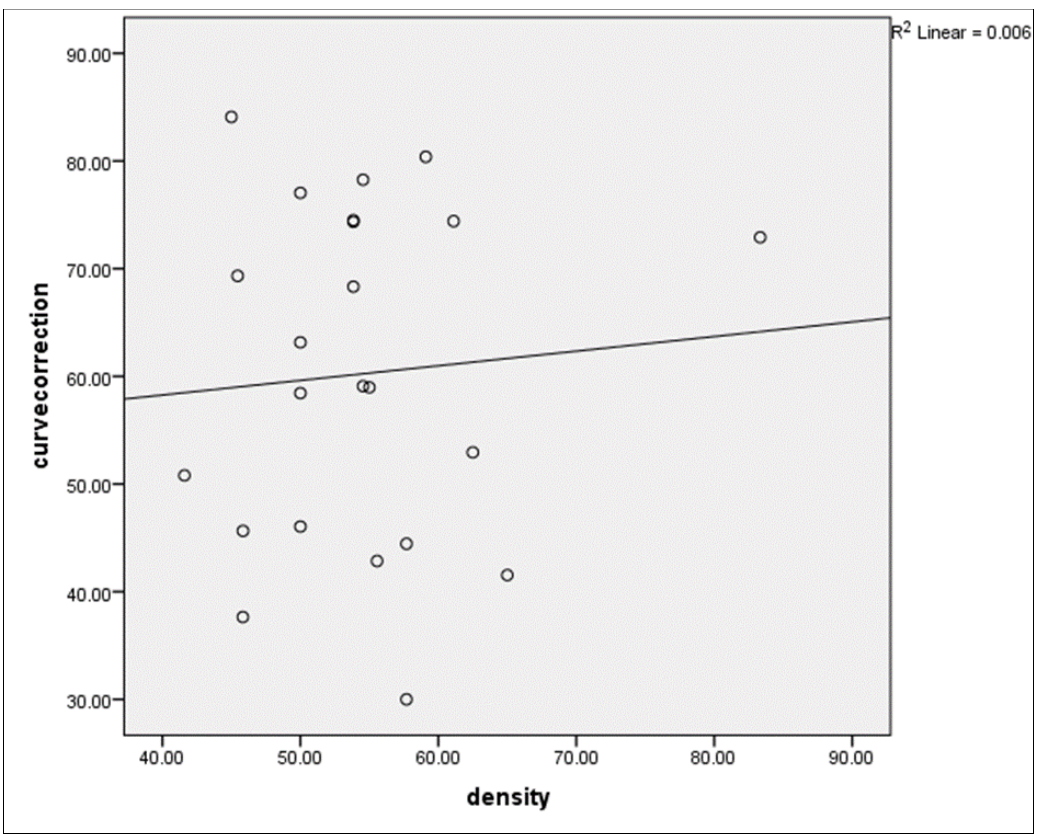
As per our study there is minimal positive correlation between implant density & curve correctability in both flexible & rigid curves which is not statistically significant. There is positive correlation between flexibility and curve correctability which is statistically significant in rigid curves.

We have not included sagittal plane parameters in our study, but the correction of the hypokyphosis element was good with pedicle screw construct. There was no loss of thoracic kyphosis.



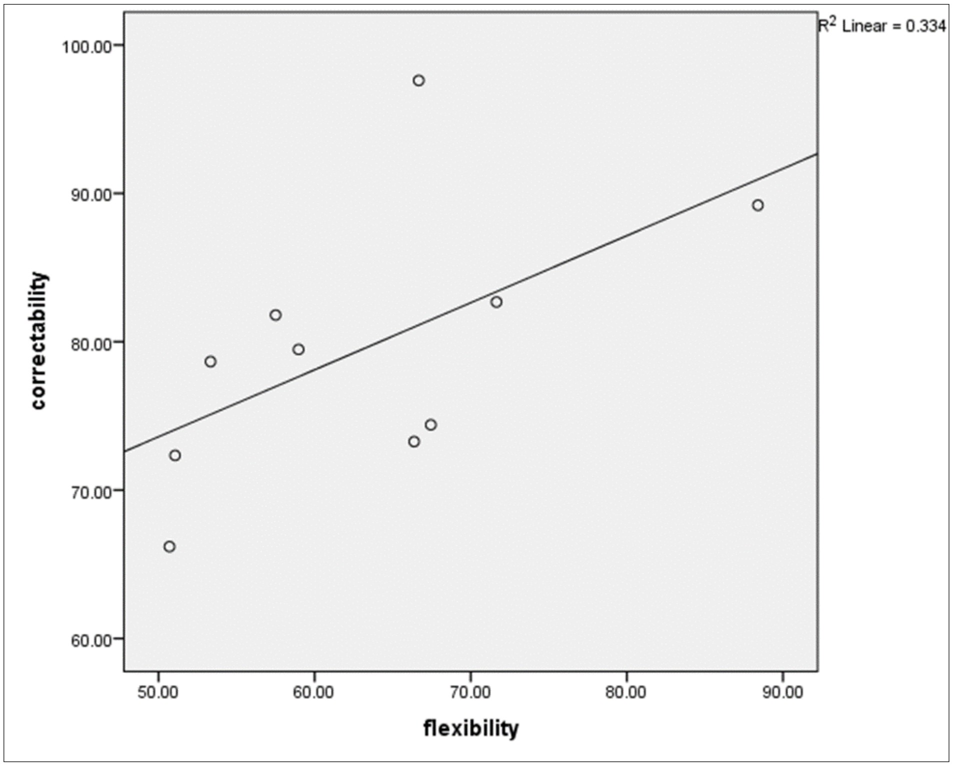
P value: 0.014
Correlation: 0.506

Fig 1: Flexibility and curve correction for rigid curves



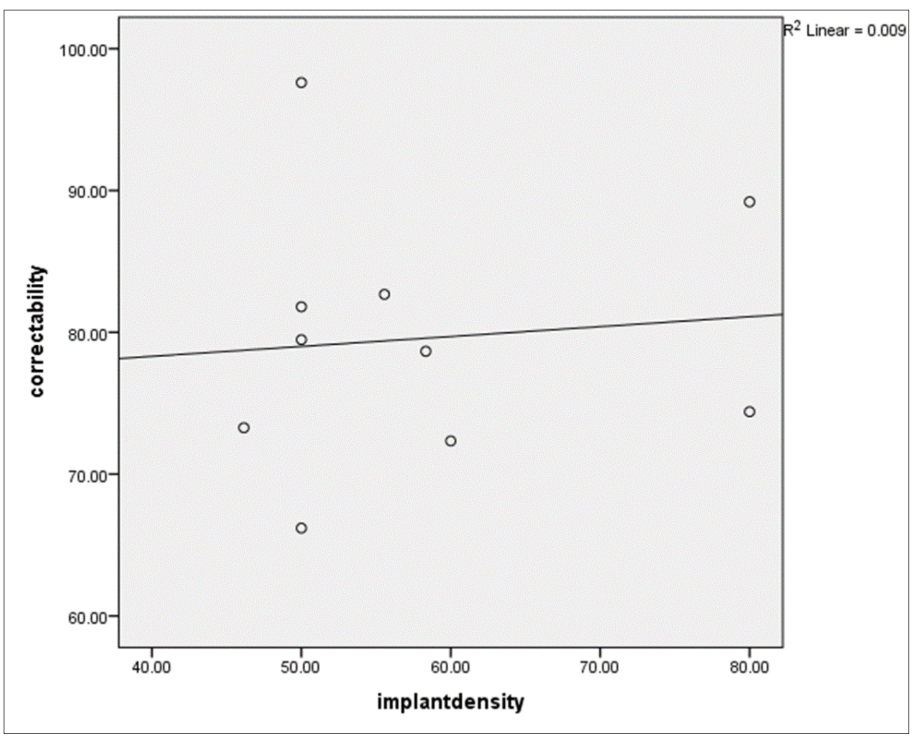
P value: 0.732
Correlation: 0.075

Fig 2: Implant density and curve correction in rigid curves



P value: 0.080
Correlation: 0.57

Fig 3: Flexibility and correctability of flexible curves



P value: 0.792
Correlation: 0.096

Fig 4: Implant density and curve correction for flexible curves

Our results are consistent with the study done by Gerald [1] *et al*, which states that there is no correlation between implant density and curve correction in adolescent idiopathic scoliosis irrespective of flexibility of curve.

As per Sandra Gerhardt [6] *et al* there is no correlation between anchor density and curve correctability, but the there is a positive correlation between curve correction and flexibility of the curve which is surgeon independent variable.

As per Jiayu chen [4] *et al* there is a positive correlation between implant density and curve correction, but no correlation between implant density and curve correction index. David Clemens [7] *et al* also states that there is a positive correlation between implant density and curve correction, especially for correcting rod, and there is loss of kyphosis associated with increased pedicle screw implant density.

Curve correction depends mainly on flexibility but not on implant density, this helps in reducing the expenses of surgery by reducing the number of pedicle screw anchors. Limitations of our study are, retrospective study and no.of subjects is less.

5. Conclusion

Curve correction depends mainly on flexiility of the curve not on the implant density. Curve correction not related to implant density.

6. References

1. Gerald MY, Quan, PhD, MD, FRCS, Mike J. Gibson, MD, FRCS. Correction of Main Thoracic Adolescent Idiopathic Scoliosis Using Pedicle Screw Instrumentation. Does Higher Implant Density Improve Correction?
2. A Noelle Larson, MD *et al* Are More Screws Better? A Systematic Review of Anchor Density and Curve Correction in Adolescent Idiopathic Scoliosis: Spine Deformity 1 2013, 237-247.
3. Xiaoyu Wang • Carl-Eric Aubin • Isabelle Robitaille, Hubert Labelle: Biomechanical comparison of alternative densities of pedicle screws for the treatment of adolescent idiopathic scoliosis: Eur Spine J 2012; 21:1082-1090.
4. Jiayu Chen, MD *et al*, Correction of Lenke 5 Adolescent Idiopathic Scoliosis Using Pedicle Screw Instrumentation. Does Implant Density Infl uence the Correction? SPINE 2013; 38 (15):946-951.
5. Hay, Douglas, Izatt, Maree T, Adam, Clayton J, Labrom, Robert D, Askin, Geoffrey N *et al*. The Use of Fulcrum Bending Radiographs in Anterior Thoracic Scoliosis Correction: A Consecutive Series of 90 Patients. Spine, 2008; 33(9):999-1005.
6. Sandra Gebhart, MD, Timothy B Alton, MD, Viviana Bompadre, PhD and Walter F. Krengel, MD Do Anchor Density or Pedicle Screw Density Correlate with Short-Term Outcome Measures in Adolescent Idiopathic Scoliosis Surgery? SPINE, 2014; 39 (2):104 -110.
7. David H. Clements *et al* Correlation of Scoliosis Curve Correction with the Number and Type of Fixation Anchors SPINE 2009; 34(20):2147–2150.