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# The comparison of the results after spinal fusion with or without iliac screw insertion in the treatment of neuromuscular scoliosis

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A B S T R A C T

*Introduction:* Neuromuscular scoliosis leads to a wide range of spinal disorders which disturb the musculoskeletal system. The aim of this study is to compare the clinical and radiological results of posterior spinal fusion with and without extending the instrumentation to iliac bones in treatment of neuromuscular scoliosis.

*Methods:* Medical records and radiographies of 36 patients with neuromuscular scoliosis who underwent posterior instrumentation between 2011 and 2015 were reviewed. Age and body mass index at time of surgery, underlying diagnosis, gender, postoperative infection rates, perioperative and postoperative blood transfusion, duration of surgery, complication rates were identified for each patient retrospectively. SF-36 physical questionnaire was applied to all patients. Surgery was performed in each patient and included posterior spinal fusion with pedicle screws from the proximal thoracic spine (T2 or T3) to S1 (Group A) or extension of distal instrumentation to pelvis by bilateral iliac screws (Group B).

*Results:* A total of 23 patients in group A were compared with 13 patients in group B. Median age was 14 (9–38) years for group A and 16 (12–25) years for group B. Median follow-up period was 20 (12–66) months. Preoperative median Cobb angles were 66° and 60° and postoperative Cobb values were 33° and 31° in group A and B respectively. Median Cobb angle reduction was 40° and 34° for group A and B. We are able to see in this study that the usage of illiac screws do not increase implant failure and help achieve better functional results.

*Conclusion:* This study shows that the extention of instrumentation to the pelvis with illiac screws can be beneficial in terms of functional and complicational incidences.

*Level of evidence:* Level III, therapeutic study.



## Introduction

Neuromuscular scoliosis leads to a wide range of spinal disorders which disturb the musculoskeletal system. Alteration of innervation and/or muscle tone causes this disturbance.[1] These spinal disorders make the spine devoid of supporting properties, as a result, sitting and ambulating become difficult. Major aim in the care of these patients is correcting scoliosis.[2] With correcting the scoliosis; easier working conditions actualize for caregivers, digestive and respiratory functions get better, sacral wounds diminish, lateral pelvic tilt and spine balance improves. With this improvement provides more suitable sitting.[3]

Surgical treatment of neuromuscular scoliosis is more challenging condition compared to idiopathic scoliosis because the curves lean to be more rigid, severe and extended.[4] Therefore long fusions that reach to sacrum and pelvis, compromising the spinopelvic junction are needed to obtain sufficient treatment. Poor bone quality and significant loads are placed on lumbosacral junction because the long spinal instrumentation leads to complications. Only S1 screw, triagulated S1–S2 screws, S1 and iliac screws, transsacroiliac screws are some of choices for spinopelvic fusion. All of them have advantages and disadvantages that lead to complications.[5–9]

Using posterior iliac screw requires extensive soft tissue dissection, extra time for rod preparation and associated with postoperative pain, bed sores leading to implant removal in 22% of the cases.[5]

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The aim of this study is to compare the clinical and radiological results of posterior spinal fusion with or without extending the enstrumentation to iliac bones with iliac screws in treatment of neuromuscular scoliosis.

## Patients and methods

Age and body mass index at time of surgery, underlying diagnosis, gender, postoperative infection rates, perioperative and postoperative blood transfusion, duration of surgery, complication rates were identified for each patient. Inclusion criteria consisted of presence of neuromuscular scoliosis and minimum 6 months of follow-up. Another inclusion criteria is patients' non-ambulatory status. SF-36 physical questionnaire was applied to all patients pre-postoperatively.If the patient is not capable of answering this questionnaire, these questions were answered by parents. Surgery was performed to each patient by same surgeon (BA) and included posterior spinal fusion with pedicle screws from the proximal thoracic spine (T2 or T3) to S1 (Group A) or extension of distal instrumentation to pelvis by bilateral iliac screws (Group B).Connecting iliac screw to S1 pedicle screw is hard by directly or lateral connector technically, as preference of the surgeon distal instrumentation was ended S1 for rigid deformities.Preoperative and postoperative radiographs were assessed for cobb angle, pelvic obliquity, lumber lordosis, thoracal kyphosis, thoracosacral angle (TSA).

### *Statistical analysis*

Variables were detailed evaluated by used statistical analysis correctly which were performed using SPSS(IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.) and the level of significance was set at $\alpha = 0.05$. Continuous variables were expressed as median (minimum:maximum) while categorical variables were presented as frequency with related percentage. Between group comparisons were performed by Mann Whitney U tests where preoperative and postoperative measurements were compared by Wilcoson test.

## Results

Medical records and radiographies of 36 patients with neuromuscular scoliosis who underwent posterior instrumentation between 2011 and 2015 were reviewed. A total of 23 patients in group A were compared with 13 patients in group B.

Median early follow-up period was 20 (12–66) months, BMI was 17 (11–30) and there was no difference between two groups for both parameters ($p = 0.070$, $p = 0.340$). Types of neuromuscular diseases were similar in both groups (Table 1).

**Table 1**
Distribution of neuromuscular diseases.

| Neuromuscular Diseases | Group A | Group B |
|---|---|---|
| Cerebral palsy | 5 | 6 |
| Meningomyelocele | 3 | 1 |
| Muscular dystrophy | 3 | 2 |
| Epilepsy | 3 | 1 |
| Syndromic | 3 | – |
| Tethered cord | 2 | – |
| Diastometamyelia | 2 | – |
| CNS tumour | 1 | – |
| Mental retardation | 1 | – |
| Friedreich ataxia | – | 2 |
| Spinal muscular atrophy | – | 1 |
| **TOTAL** | **23** | **13** |
| **Median age** | **14 (9–38)** | **16(12–25)** |

### *Radiological results*

Preoperative median Cobb angles were 66° (31°:129°) and 60° (41°:113°) and postoperative Cobb values were 33° (4°:86°) and 31° (10°:58°) in group A and B respectively. Median Cobb angle reduction was 40° and 34° for group A and B. For group A and B, postoperative Cobb angles were statistically different from preoperative values respectively ($p < 0.001$, $p = 0.001$) (Table 2).

Thoracic kyphosis was measured for each group and preoperative values were 28° (-3°:67°) and 26° (2°:46°) and postoperative values were 21° (5°:84°) and 26° (6°:49°) in group A and B respectively. Also median preoperative lumbar lordosis were 41° (8°:60°) and 40° (−22°:58°) and median postoperative values were 45° (8°:73°) and 42° (14°:72°) in group A and B respectively (Table 2).

**Table 2**
Radiologic results for both groups.

| | Preoperative | Postoperative | Median correction | p Value |
|---|---|---|---|---|
| | **Group A** | | | |
| Cobb Angle | 66° | 33° | 40° | **<0.001** |
| Thoracal Kyphosis | 28° | 21° | 0° | 0.679 |
| Lumbar Lordosis | 41° | 45° | 1° | 0.339 |
| Pelvic Obliquity | 5° | 5° | 1° | 0.944 |
| TSA | 14° | 9° | 4° | **0.002** |
| | **Group B** | | | |
| Cobb Angle | 60° | 31° | 34° | **0.001** |
| Thoracal Kyphosis | 26° | 26° | 3° | 0.859 |
| Lumbar Lordosis | 40° | 42° | 5° | 0.152 |
| Pelvic Obliquity | 14° | 7° | 8° | **0.002** |
| TSA | 10° | 3° | 4° | 0.063 |

Preoperative and postoperative median pelvic obliquity angles were identical and 5° (0°:31°) in group A. However, in group B preoperative mean pelvic obliquity was 14° (1°:35°) and was 7° (0°:21°) postoperatively ($p < 0.05$). TSA measurement showed us that preoperative median values were 14° and 10° for group A and B, postoperative values were 9° and 3° for group A and B respectively. Median TSA correction was 4° for both groups. Only for group A the TSA correction angle was statistically significant ($p = 0.002$) (Table 2).

### *Clinical results*

Surgical infection rate (A:3 B:1), median bleeding amount (A:420 ml B:432 ml), erythrocyte replacement and operation time were all similar in group A and B ($p > 0.05$). Complications in group A were; 2 (0.7%) pseudoarthrosis, 1 (0.8%) rod fracture and 1 (2.8%) dura injury. No complication was recorded for group B.

Patient's physical SF-36 scores were evaluated. Group A and B preoperative physical SF-36 scores were 54 (33:68) and 55 (34:61) respectively postoperative scores were 54 (36:70) and 60 (39–88) respectively. Improvement of patient physical SF-36 were 3.7 for group A and 7.6 for group B so the difference was statistically significant ($p = 0.007$).

Parent functional and mental SF-36 values were also assessed by asking these questionare at polyclinic controls. Preoperative group A and B functional SF-36 values were 95 (85:99) and 94 (89:99). Postoperative functional SF-36 values were 94 (91:99) and 95 (90:99). No statistically significant difference was detected ($p = 0.897$). Also parent mental preoperative SF-36 values were 75 (61:85) and 67 (60:80) for group A and B. Postoperative it was 72 (63:84) and 73 (62:81) for group A and B. No statistically significant difference was detected ($p = 0.537$).

## Discussion

The hypothesis we would like to test in our study is the result that by iliac screw is applied to illiac bone achieving a higher cobb degree, correction of pelvic obliquity and TSA and thus improving patients and patient care takers-relatives' quality of life in comparison to those without the illiac screw.

In our study we have worked with –in terms of the underlying diseases-a very heterogeneous patient group. Surgical indications were the existance of progressive spinal deformities or spinal deformities that affected the sitting balance. The surgical method we used in every case was to use pedicle screws in order to achieve posterior stabilization by iliac screw is applied to illiac bones or not. Phillips[10] noted that screwing two screws into both illiac bones results in a better correction but we have achieved great results with one iliac screw on each side.

In the literature SF-36 physical score was used in scoliosis article.[11] Evaluating SF36 results, on the group which used illiac screw, there was a considerable increase in patients' quality of life yet no change in their relatives'. Obid and Ark [12] in their 46 chronicle case series, in their studies evaluating patients' quality of life post-NMS surgery, they mentioned that the quality of life for the patients were increased. In the same study they found that 90 percent of the patients wanted to be re-operated on. Suk and Ark [13] in their 73 chronicles studies, evaluated the relatives of the patients who independently of the surgical method went under NMS, and found out that there were not statistically recognizable changes. In our studies, we could not find a difference in patients' families' lives either yet we have detected a significant raise in patient's quality of life index.

It is thought that if the pelvic obliquity is $>15°$, pelvic fixation is needed but if $<15°$, it is not needed. But for us, another indication of pelvic fixation is to correct TSA values that cause sitting imbalance. So in our study we have achieved an average of 4° TSA correction in both groups and we believe that this affects the correction in functional results.In excessively deformed spines which have an increased pelvic obliquity, the rod needs to be extended till the pelvis. But the rods are very hard to apply to this anatomy and they increase the surgical duration and bleeding. Zahi and Ark [14] in their studies, in 62 case they performed spinopelvic fixation with illiac screws and they have examined the connecting method of the spinal rods to the illiac screws. In patients with spinopelvic balance they have directly connected the rods to the illiac screws whereas in patients with pelvic obliquity they have managed this connection with connectors. In cases they used connectors, they have mentioned that the 3D bending manoeuvres applied to the rods to stabilize spinal balance was easier to do and they have passed one of the technical problems in spino illiac fixation this way.

The limitations of our study are the low number of patients and their short length of follow up. With a higher density of patient population and a longer period of follow up would help define the pros and cons of illiac screw usage, more definitively. On top of this, in our study there was no separate evaluation based on whether our patients had a neurosurgical interference in the past based on a previous neuromuscular disease. It is unknown to which degree such an interference would affect the patients' radiologic and functional results. We believe this factors should also be taken in consideration and to select a patient group accordingly to it would be more beneficial.3 patients underwent neurosurgical procedure for diastematomyelias and tethered cord.Because of small number we consider to insignificantly.

## Conclusion

In conclusion, we are able to see in this study show spinopelvic fusion with iliac screw do not increase implant failure and help achieve better functional results. In the light of these informations, this study shows that the extention of instrumentation to the pelvis with illiac screws can be beneficial in terms of functional and complicational incidences.

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