Abstracts Virtual NSDS 2021

Abstract : # 16

List of Authors

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Title

Internal bracing effect of expandable implants in surgical treatment of patients with congenital scoliosis

Background

Growth preservation techniques utilizing rib based devices remain to be a method of treatment for patients with congenital thoracic spine deformities. In general its aim is in achieving correction and improving thorax development. Recently latter was critically exposed showing that no significant improvement in lung function occurred during treatment same as for quality of life which also didn't change. We were aimed to evaluate whether or not these surgical procedures allow achieving real correction of the deformity by comparing the curves at the starting point and at the end-point of surgical treatment.

Method(s)

Single-center retrospective cohort observational study was performed. Data of 14 surgically treated patients were evaluated. All patients had congenital scoliosis due to multiple anomalies of the thoracic region which made them possible for the rib-based correction devices to be used. We analyzed pre-op and post-op scoliotic and kyphotic curve values, Th1-Th12 height was measured to evaluate the growth of the thoracic region. Amount of surgical procedures, type of instrumentation and efficacy of curve correction during each surgical stage were analyzed.

Results

There were 40 surgical procedures performed in total. Mean amount of procedures per 1 patient was 3±1. Mean scoliotic and kyphotic curves pre-op were 70.3^0±23.7^0 and 32.8^0±13.0^0 respectively. At the end point mean scoliotic and kyphotic curves were 63.9^0±24.0^0 ($p>0.05$) and 30.7^0±11.0^0 ($p>0.05$) respectively. Mean Th1-Th12 height was 17.0±8.2 cm at the beginning and 17.4±9.0 cm at the end. There were 6 patients with rib-rib and 8 patients with rib-spine implants. Mean curve correction with rib-spine implants during one stage was 8.55^0 and with rib-rib devices it was 4.62^0 ($p=0.049$).

Conclusion

Growth preservation techniques utilizing rib based devices in patients with congenital thoracic spine deformities act primarily as a method for stabilization of further curve progression thus serving as an "internal brace" requiring multiple surgeries. Rib-spine implants provide significantly better staged correction comparing to rib-rib devices.

Abstract : # 18

List of Authors

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Title

EOS, O-arm and standard spine radiographs; what is the cumulative radiation exposure during current scoliosis management?

Background

During the course of treatment for adult idiopathic scoliosis (AIS), patients are subjected to repeated radiological exposure. Only a few studies have evaluated the total absorbed radiation dose during follow-up for scoliosis. To the best of our knowledge, this is the first study to evaluate total radiation dose exposure from all modalities for a cohort of AIS patients. The aim of this study was to determine the radiation exposure of AIS patients and to compare follow-up algorithms among different international spine centers.

Method(s)

A retrospective review on radiation exposure of patients treated for AIS. Inclusions: patients followed for AIS at our institution from 2013-2016 without neuromuscular disease. The O-arm cone-beam CT scanner was used for 3D navigation in all surgically managed patients, low dose protocols were used (70kVp, 80mAs). A survey asking for information on radiological algorithms and imaging frequencies was sent to a number of international spine centers.

Results

61 patients were included, 19 were treated conservatively (M/F: 6/13) and 42 surgically (M/F: 11/31). Median follow up time for the conservative group was 9 (range 0-52) months and 38 (range 13-163) months for the surgical group. Median number of X-rays/ EOS were; 4 (range 0-20)/2 (range 0-17) for the conservative group and 15 (range 2-57)/ 11(range 0-26) for the surgery group. Patients undergoing surgery received a median cumulative radiation dose of 10.31mSv (range 3.79-20.43) vs. a median dose of 1.09mSv (range 0.22-7.17) for those treated conservatively. Approximately 25% (39.04/161.82mSv) of total intraoperative radiation dose for all patients was a result of O-arm 2D fluoroscopy. The results of the questionnaire showed great variety of radiological follow-up algorithms among 8 spine centers without adherence to any of the published consensus statements.

Conclusion

Surgically treated patients were exposed to more radiation than those treated conservatively owing mainly to intraoperative 3D scans and a larger numbers of radiological follow-up examinations. The use of cone-beam CT-based 3D navigation elevates patient safety during deformity surgery. However, patients are potentially exposed to a significant amount of radiation depending on protocol and use of 2D fluoroscopy. Further awareness to reduce radiation exposure is warranted.

Abstract : # 23

List of Authors

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Title

The efficacy of the Maastricht brace in the treatment of adolescent idiopathic scoliosis

Background

The Maastricht brace (M-brace) has been developed to improve patient compliance and associated efficacy of brace treatment in adolescent idiopathic scoliosis (AIS). Its main features are anterior closure, an elastic thoracic pelotte and comfortable material use. The emphasis is on wearability and comfort for the patient, whilst retaining corrective pressure function. Initial pressure measurements in the M-brace revealed an equal corrective pressure as compared to the Boston brace, and a better patient reported quality of life as measured with the SRS 22 and Brace questionnaire. First results of the efficacy in terms of radiographic curve correction of the M-brace in AIS were promising, with an average in-brace curve correction of 48.6%. The aim of this study was to evaluate the end-term radiological results of the first group of patients treated with the Maastricht brace, with a minimum of one year follow up after stop of brace wearing. The aim of this study was to evaluate the efficacy the Maastricht brace in the treatment of adolescent idiopathic scoliosis

Method(s)

A total of 105 patients, 88 females, with adolescent idiopathic scoliosis (AIS), who have been treated with the M-brace since January 2011, were included. Inclusion criteria for the study are those of the SRS inclusion criteria on bracing, except the range of Cobb angles which was extended to curvatures of up to 45°. Patients were followed up until one year after stop brace wear. Failure of the brace treatment was defined as progression of the curve to a magnitude of above 45 degrees, for which spinal fusion was indicated.

Results

The mean age was 13 (± 1.7) years. Average Risser grade was 1.9 (± 1.7) Predominantly Lenke curve type 1 (n=65). The average primary curve angle measured in Cobb degrees was 35.1° ± 10.1°. The average primary curve angle in bending x-rays was 13.3° ± 8.5°. In the M-brace the primary curve angle was 24.5° ± 10.0°. The average end-term primary curve angle was 31.7° ± 8.6°. There were 27 failures (26.2 %) in this group, of which 8 were male. Predominant Lenke curve type 1 (16). In brace correction of the failure group did not differ significantly from the success group (p 0.12).

Conclusion

These first end-term results demonstrate an overall adequate correction effectiveness with the M-brace, with end term results comparable to the success rate of 72% in the BRAIST study. Future compliance research is imminent in order to objectify the expected wearability and comfort.

Abstract : # 95

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Title

Thoracic Morphology and Bronchial Narrowing Are Related To Pulmonary Function in Adolescent Idiopathic Scoliosis

Background

The principal pulmonary dysfunction in AIS is believed to be restrictive. Recently, it has been reported that an additional obstructive pulmonary component is frequently present in thoracic AIS. In this study we evaluate chest deformity, lung volumes and airway dimensions to better understand the mechanisms behind lung function impairment in preoperative patients with thoracic AIS. The hypothesis will be tested that ventilatory dysfunction in preoperative AIS patients is not only restrictive, but also obstructive as a result of spinal chest intrusion and spine-airway proximity.

Method(s)

Spinal radiographs, low-dose CT scans of the spine including the chest and pulmonary function tests were retrospectively collected for 85 preoperative thoracic AIS patients in two centers and compared to 14 matched controls. Three-dimensional lung and airway reconstructions were acquired. Correlation analysis was performed between radiographic spinal parameters, CT-based chest deformity parameters (rib-hump index (RHi), spinal penetration index, endothoracic hump ratio, hemithoracic-width ratio), lung volume asymmetry and 3-D bronchial diameters versus percent-predicted spirometry results.

Results

41 (48%) patients had a FEV1% or FVC% below 65% and 17 (20%) had obstructive lung disease. All chest deformity parameters correlated significantly with FEV1% and FVC%, RHi was the strongest correlate (rs = -0.52 and -0.54 respectively). AIS patients with impaired pulmonary function had a smaller thoracic kyphosis, larger rib hump, increased spinal and thoracic rotation, a narrower right hemithorax and increased intrusion of the spine into the chest. Increased spinal intrusion correlated with right-sided bronchial narrowing, relative right lung volume loss and decreased FEV1% and FVC%. Multivariate regression including spinal and thoracic deformity parameters, lung volume asymmetry and airway parameters could explain 57% of the variance in FEV1% and 54% of FVC%.

Conclusion

Chest intrusion by the endothoracic hump is related to right-sided bronchial narrowing and lung function loss in preoperative AIS. The findings support that ventilatory dysfunction in thoracic AIS is not only restrictive but frequently has an obstructive component, especially in patients with hypokyphosis. RHi is the most predictive chest parameter for lung function loss.

Spinal intrusion and endothoracic hump formation in AIS is linked to hypokyphosis and can cause right-sided airway narrowing and FEV1% loss in preoperative AIS patients.

Abstract : # 99

List of Authors

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Title

Serum metal ion levels following spinal deformity surgery: A case-control study of 182 individuals.

Background

Insertion of implants may be associated with increased levels of metal ions. The aim of this study is to evaluate the levels of cobalt (Co), chromium (Cr) and titanium (Ti) after instrumented spinal fusion for scoliosis.

Method(s)

91 individuals who had undergone scoliosis fusion surgery with stainless steel (n=71) or titanium implants (n=20) were identified. Serum samples were collected at median 2.24 years after surgery. They were sex- and age-matched with 91 non-surgically treated individuals. Serum levels of Ti, Cr and Co were measured using inductively coupled plasma sector field mass spectrometry (ICP-SFMS).

Statistical analyses were performed with Mann-Whitney or Spearman tests.

Results

In the 91 surgically treated individuals median (25th, 75th percentile) level of Ti was 0µg/l (0µg/l, 0µg/l) and in the 91 non-surgically treated individuals 0µg/l (0µg/l, 0µg/l), p<0.001. Corresponding results for Cr were 0.54µg/l (0µg/l, 1.06µg/l) vs. 0µg/l (0µg/l, 0µg/l), p<0.001 and for Co 0.29µg/l (0.18µg/l, 0.38µg/l) vs. 0.24µg/l (0.18µg/l, 0.35µg/l), p=0.188.

In the 71 individuals with steel implants and their 71 controls no Ti was detected. Corresponding results for Cr was 0.63µg/l (0µg/l, 1.14µg/l) and 0.00µg/l (0.00µg/l, 0.00µg/l), p<0.001 and for Co 0.27µg/l (0.17µg/l, 0.36µg/l) and 0.23µg/l (0.17µg/l, 0.31µg/l), p=0.359.

In the 20 individuals with titanium implants median level of Ti was 4.31µg/l (3.27µg/l, 6.48µg/l) and in their 20 sex- and age-matched non-surgically treated individuals 0µg/l (0µg/l, 0µg/l), p<0.001. Corresponding results for Cr was 0µg/l (0µg/l, 0.60µg/l) vs. 0µg/l (0µg/l, 0µg/l), p=0.384 and for Co 0.39µg/l (0.23µg/l, 0.49µg/l) vs. 0.31µg/l (0.20µg/l, 0.40µg/l), p=0.267.

In the subgroup of individuals with steel implants a correlation between implant time in situ and level of Cr was found (r=-0.515, p<0.001) but not with Co (r=-0.144, p=0.231). Ti was not detected.

In the subgroup of individuals with titanium implants, there was no correlation between implant time in situ and level of Ti (r=0.221, p=0.350), Co (r=-0.125, p=0.600) or Cr (r=0.358, p=0.122).

Conclusion

The use of stainless steel and titanium implants in spinal fusion surgery is associated with elevated metal ion concentrations several years after surgery. Whether these serum ion levels are associated with adverse health outcomes is currently unknown.

Abstract : # 100

List of Authors

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Title

Patient-related outcomes at two-year follow-up in adolescent idiopathic scoliosis surgery – What matters to patients.

Background

Technical success of fusion surgery for adolescent idiopathic scoliosis (AIS) is meaningless when it does not add value for patients. To determine the value of scoliosis surgery in the future, it is necessary to evaluate outcomes on domains that matter to patients. Especially in AIS care where randomized trials are scarce, prospective cohort studies with comparable outcome measures are important. To enhance comparison, a core set of patient-related outcome measures is available.

Purpose: To evaluate the outcomes of AIS fusion surgery at 2-year follow-up using the core outcomes set.

Method(s)

Adolescents and young adults with idiopathic scoliosis are systematically monitored and PROMs (SRS-22r, EQ5D, EQ-VAS [quality of life]; ODIv2.1a [functional status]; NRS back-& leg-pain) and clinician-reported outcomes (complications, revision surgery) are recorded. Changes in PROMs (preoperative, 1- and 2-year follow-up) were analyzed using Friedman's ANOVA. Clinical relevance was determined using minimally important changes (SRS-22r), cut-off values for relevant effect on functioning (NRS) and a patient acceptable symptom state ([PASS]; ODI).

Results

144 of 246(59%) AIS patients undergoing primary surgery between 2014-2016, aged≤25 years (median 15yrs; 11-24) were included. Mean NRS back-pain was 4.4(±2.7) at baseline and 65/144(45%) patients reported NRS back-pain scores>5. All PROMs significantly improved at 2-year follow-up and improvements in SRS-22r function(+1.2), pain(+0.6) and self-image(+1.1) domain scores, as well as the SRS-22r total score(+0.5), were clinically relevant. Mean NRS back-pain at 2-year follow-up was 2.1(±2) and 14/144(10%) patients reported NRS>5. 135/144(94%) patients reached PASS(≤22) on the ODI. Complications: 9/144(6.3%). Revision surgery: 2/144(1.4%). Surgical site infections did not occur.

Conclusion

Fusion surgery for AIS is a successful procedure to prevent curve progression. This current study aimed to quantify the benefits of surgery on domains that are important to patients. Relevant improvement in functioning, condition-specific and health-related quality of life, self-image and a relevant decrease in pain is shown at 2-year follow-up, with few adverse events. Contrary to the general perception that AIS is a largely asymptomatic condition, nearly half of patients report significant back-pain pre-operatively, which reduced to 10% at 2-year follow-up. These results show fusion surgery for AIS is not only cosmetic surgery.

Abstract : # 101

List of Authors

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Title

AO Adult Spine Deformity Patient Profile - A paradigm shift in comprehensive patient evaluation in order to improve patient care

Background

Adult spinal deformity (ASD) causes a significant health-care burden compared to other chronic conditions. It impacts patients' health and functional status. In contrast to adolescent idiopathic scoliosis where classification and surgical decision-making is mainly based on radiological parameters, treatment management of ASD requires a holistic multimodal (bio-psychosocial) approach that considers etiology, clinical presentation, radiographic findings, and patient's general condition. The available ASD classifications are predominantly radiological in nature, which fail to address the full spectrum of the condition. A comprehensive, uniform and clinically oriented patient profile in which information is systematically captured on relevant factors that drive decision-making, is lacking.

Purpose: To develop a comprehensive multimodal ASD patient profile and to test its feasibility.

Method(s)

A three-part mixed methods study was performed. Part 1: Development of prototype of a patient profile. The ASD core outcomes set as developed by Scoliosis Research Society (SRS) was categorized into a conceptual framework. Part 2: Modified Delphi study. Worldwide, 51 panelists participated in a four-round iterative process, including a face-to face-round (threshold for agreement: 70%). Part 3: Feasibility test. Content validity and usability were evaluated quantitatively, using a survey among nine experts independent from the Delphi panelists.

Results

The developed profile consists of four domains: 1. General health (demographics, comorbidities), 2. Spine-specific health (spine-related health, neurological status), 3. Imaging (radiology, MRI), and 4. Deformity type. Each domain consists of one or two components with bio-psychosocial factors and their respective measurement instruments. All the domains are designed as individual drivers of decision-making without any hierarchy. The profile has excellent content validity (item relevance content validity index [I-CVIr] 0.78-1.00; Average-CVI 0.92), appropriateness, relevance, and usefulness.

Conclusion

The AOASD Patient Profile provides a universally applicable bio-psychosocial approach to methodically describe patients. Information of relevant factors that influence and drive decision-making in treatment management and treatment outcomes of ASD are systematically collected. The profile has excellent content validity and is useful for clinical practice. Different combinations of factors could indicate condition severity, support patient counselling, and facilitate post-operative risk stratification. Ultimately, identifying groups of ASD patients with similar profiles, potentially supports classifying ASD and clinical decision-making.

Abstract : # 103

List of Authors

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Title

To evaluate the ability to recognize a scoliosis by parents before and after educating them on how to detect adolescent idiopathic scoliosis (AIS).

Background

In countries where scoliosis screening programs ended, the responsibility of scoliosis detection shifted from health care professionals to parents. In the absence of scoliosis screening, more patients are presenting late in orthopedic clinics with curvatures exceeding the upper limit of brace treatment, resulting in an increased rate of patients undergoing surgery. Increased awareness of scoliosis may favor the appropriateness of referral. This study examines the effect of education on their ability to detect scoliosis by parents.

Method(s)

In this cross-sectional study, parents had to complete a survey. The survey presented two series of 14 cases of children (8 with AIS and 6 without) and each case displayed two photographs (standing position & full-flexion during the forward-bending test). Based on visual inspection of the spine, parents had to indicate if the child had to be referred to a physician. After assessing the first series, parents were educated on how to detect scoliosis, after which they had to assess the second series of cases. The diagnostic accuracy measures were calculated before and after education.

Results

Digital surveys were completed by 100 untrained parents. The sensitivity for recognizing scoliosis was significantly higher after education (74.0% [95% CI, 70.8 – 77.0]) compared to before education (68.8% [95% CI, 65.4 – 72.0]; p=0.002), while the specificity of the screening was not significantly different with a specificity of 74.0% [95% CI, 70.8 – 77.0] before and 74.8% [95%, 71.2 – 78.3] after information (p=0.457).

Conclusion

This study showed that education improved the ability to detect scoliosis by parents without increasing the false positive referral rate. The appropriate referral rate increased significantly from 68.8% to 74.0%, while the specificity was not significantly different, indicating that education can improve appropriate referral rate of scoliosis patients by parents.

Abstract : # 105

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Title

PReventing Idiopathic SCOliosis PROgression (PRISCOPRO): a protocol for a multicenter, quadruple-blinded, randomized controlled trial comparing 3D designed Boston brace to standard Boston brace

Background

Idiopathic scoliosis is the most common spinal deformity in children. Treatment strategies aim to halt progression of the curve. Patients are treated mainly with thoracolumbosacral orthosis (TLSO) if indicated. This form of brace treatment has been shown to be cumbersome and tough on growing individuals. However, computer aided design and manufactured (CAD/CAM) braces might increase comfortability and ultimately outcome if compliance is improved. In a multicenter, randomized controlled trial, we aim to compare CAD/CAM designed Boston 3D-brace to standard Boston brace.

Method(s)

Subjects: 170 previously untreated and skeletally immature children diagnosed with idiopathic scoliosis, aged 9-17 years of age (curve magnitude Cobb 25-40 degrees) will be included.

Interventions: Both groups will receive a physical activity prescription according to the World Health Organization recommendations. Randomization will be performed 1:1 to a 3D CAD/CAM designed Boston 3D-brace or a standard Boston brace, both with prescribed daily wear time of 20 hours.

Outcome: The subjects will participate in the study until curve progression or until skeletal maturity. The primary outcome variable is failure of treatment, defined as progression of the Cobb angle more than 6 degrees compared to the baseline x-ray. The progression is confirmed if seen on two consecutive standing spinal x-rays. Radiographs will be taken at each six-month follow-up. Secondary outcome measures include patient and clinical reported outcomes, including number of individuals requiring surgical intervention.

The protocol has been registered on ClinicalTrials.gov, identifier: NCT04805437

Results

This is a protocol for a randomized controlled trial.

Conclusion

This study will show if efficacy in brace treatment can be improved with new brace designs.

Abstract : # 106

List of Authors

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Title

High failure rates of a unilateral posterior peri-apical distraction device (ApiFix®) for fusionless surgical treatment of adolescent idiopathic scoliosis

Background

Conventional surgical treatment for adolescent idiopathic scoliosis (AIS) consists of correction of the spinal deformity with rigid spinal instrumentation and fusion. Less-invasive and fusionless surgery could potentially improve patient outcome. The aim of this paper is to study the efficacy of a - recently FDA approved - posterior peri-apical self-distracting device (ApiFix®) that is designed to gradually correct the deformity without spinal fusion.

Method(s)

In a prospective cohort study of 20 patients with AIS, Risser stage 1-4, Lenke 1 or 5, major curve Cobb angle 40-55° and Bunnell Scoliometer rotation <15°, ApiFix® was used. Clinical and radiographic performance was assessed.

Results

Twenty patients aged 14.8 ± 1.4 years were treated and followed for 3.4 ± 1.0 years. The average major curve was reduced from 45.4° pre-operatively to 31.4° at 2 weeks post-operatively and 31.0° at final follow-up. The minor curve measured 31.3° pre-operatively, 26.1° at 2 weeks post-operatively and 24.2° at final follow-up. Twelve patients had serious complications which required revision surgery due to osteolysis (N=6), screw and/or rod breakage (N=3), failure of the ratchet mechanism (N=1), damage polyaxial joint (N=1) or pain without explainable cause (N=1). During revision surgery metallosis was observed in all patients and cultures showed Cutibacterium Acnes in eight patients. Due to the high failure rate the study was terminated early.

Conclusion

The use of the unilateral peri-apical concave self-distracting ratchet rod was initially associated with promising clinical and radiological results. However, no distraction was observed and the high rate of serious adverse events within 2 years was considered unacceptable for further clinical application of this device in our institution, despite recent FDA approval.

This study will show if efficacy in brace treatment can be improved with new brace designs.

Abstract : Entry # 107

List of Authors

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Title

Is a night time side bending brace the new standard to prevent progression of double curves in patients with an adolescent idiopathic scoliosis.

Background

Treatment with rigid bracing is the most common non-operative treatment for the prevention of curve progression. Brace treatment (18-22/24 hrs) has been proven effective for flexible double curves in youngsters with growth potential with a primary curve between 20 and 40 degrees.

Purpose: to evaluate the outcome of treatment with the Boston modified night brace (BNB) with a lumbar pelota, compared with the Boston day brace (BDB), in patients with adolescent idiopathic scoliosis (AIS) who are at risk for curve progression.

Method(s)

Patients with AIS are systematically documented in an institutional registry . Inclusion criteria: all girls aged between 10-15 years old, at most 1 year post- menarche, a primary curve between 20-40°. In addition to the Scoliosis Research Society inclusion criteria for brace studies, a compensatory curve of 5°. Demographics, Cobb angles before initiation of brace treatment, in-brace, at 12 and 24 months and conversion to operative treatment were recorded. Differences in Cobbs angle were described and analyzed using the Wilcoxon Signed Ranks Test. Clinical relevant curve progression between both groups was evaluated with the Fisher's Exact test

Results

16/16 (100%) with a BDB and 29/34 (85%) with a BNB were included. Patient and curve characteristics were similar for both groups. At 24 months 4 (25%) BDB and 7 (24%) BNB patients did not complete the brace treatment due to progression requiring operative treatment. At 24 months a relevant curve progression was seen in 3/12 (25%) thoracic and 4/12 (33%) lumbar in de BDB group and 10/22 (45%) thoracic and 11/22 (50%) in the BNB group, all not significantly different. The median thoracic and lumbar curve progression at 24 months for respectively the BDB and the BNB were: thoracic 4° (-11, 19°) versus 6° (-7, 20) (p=0.345) and for the lumbar curves 3° (-6, 20°) versus 6° (-8, 28°) (p=0.204)

Conclusion

In patients with AIS the BNB seems to perform as well as the BDB. Overall, a tendency of a higher curve progression over time in the BNB group is seen. A significant difference in relevant curve progression between both groups was only shown for the lumbar curves between the start of brace therapy and 12 months follow-up, with a higher progression in the BNB group. Possibly our indications for BNB were too broad and only milder compensatory lumbar curves should be accepted for BNB. Nevertheless, the night time brace does have a lower burden on the social aspect of daily life of adolescents and remains a good alternative. Further research on its performance in different curve types might clarify the optimal indication for BNB.

Abstract : Entry # 110

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Title

Pelvic obliquity correction in scoliosis surgery in cerebral palsy - A radiographic analysis of 208 patients

Background

Fusion surgery is the definitive treatment for patients with cerebral palsy and scoliosis. There is no consensus whether the pelvis should be included in the fusion or not. Our aim was to compare radiological outcome in individuals fused to the fifth lumbar vertebra (L5) vs. the sacrum (with or without iliac fixation).

Method(s)

208 patients with cerebral palsy treated with fusion surgery between ages 10 through 25 years and registered in the national quality registry Swespine were analyzed. Radiographs were collected. Complications and reoperations were collected from the registry. Statistical comparisons were made with the Welch-Satterthwaite t-test, Chi-square or Fisher's exact test.

Results

58 patients were fused to L5 and 150 patients to the sacrum or below. Mean (SD) age at surgery was 15.7 (3.3) and 15.2 (3.3) years, respectively (p=0.36). Preoperative pelvic obliquity was 18° (12°) in the L5 group and 23° (14°) in the sacrum group (p=0.010). Mean preoperative Cobb angle of the major curve was 67° (19°) in the L5 group and 71° (21°) in the sacrum group (p=0.17).

Pelvic obliquity correction was 9° (10°) in the L5 group and 13° (12°) in the sacrum group (p=0.008), but percentage correction did not differ (p=0.53). Postoperative Cobb angles of the major curve were 29° (17°) and 33° (16°), respectively (p=0.16), with similar percentage correction (p=0.20). Implant density did not differ between the groups (p=0.90), but the proportion of pedicle screws was higher in the L5 group (97%) compared to the sacrum group (89%) (p<0.001).

Operative time was 318 (98) mins in the L5 group vs. 365 (116) mins in the sacrum group (p=0.006). Blood loss was 2000 ml (1600) in the L5 group and 1400 (1000) ml in the sacrum group (p=0.009). 8 (14%) and 22 (15%) individuals sustained at least one complication (p=0.87) and 5 (9%) and 14 (9%) required at least one reoperation (p=0.87), respectively.

Conclusion

Operating to the sacrum resulted in a slightly better total correction of pelvic obliquity at the expense of a longer operative time. No differences were seen regarding correction of the major curve or the frequency of complications.

Abstract : # 112

List of Authors

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Title

Brace and Physiotherapeutic Scoliosis Specific Exercises (PSSE) for Adolescent Idiopathic Scoliosis (AIS) treatment: A prospective study following Scoliosis Research Society (SRS) criteria

Background

A growing scientific evidence for conservative treatment of AIS has recently occurred, using PSSE for mild and bracing for moderate curves. Bracing have proved its superiority to natural history and is recommended by SRS. Few studies have combined PSSE and bracing, showing promising results. Our aim was to investigate the effectiveness of bracing along with PSSE for AIS treatment.

Method(s)

Prospective study, enrolling all eligible subjects from a prospective database. SRS research inclusion criteria were used (>10 years, 25o – 40o, Risser 0-2, < 1-year post-menarche, no prior treatment). 102 consecutive patients (87 females-15 males, mean age 12.8 years, Risser 0.48, Cobb Thoracic 29.2o, Lumbar 27.8o) followed treatment with Cheneau type brace and PSSE. Average follow-up time was 26.4 months. A scale from A to C was used to evaluate compliance with brace and PSSE (A: full-compliant, B: partially compliant, C: non-compliant). A threshold of 5o defined progression or improvement. 7 subjects dropped-out (6.8%), so finally 95 patients included for statistical analysis, using paired t-test.

Results

62 patients (65.3%) remained stable, 22 improved Cobb angle >5o (23.2%) and 11 progressed (11.5%). The mean in-brace correction (IBC) was 49.7% for thoracic curves and 61.7% for lumbar curves, post-treatment thoracic Cobb was 29.9o and lumbar 27o. A subsequent analysis for the progressed cases revealed that IBC was lower than average (31.7% for thoracic and 34.4% for lumbar curves), 9 patients (81.8%) were classified as C for brace compliance and 7 patients (63.6%) as C for PSSE compliance. Only 4 subjects (3.9%) progressed above 40o, reaching the surgical indication range. Another analysis for the full-compliant group, both for brace and PSSE (62 participants – 65,3%), showed significantly greater effectiveness ($p=0.005$) than overall average, as 44 patients (70.9%) stabilized Cobb angle, 18 (29.1%) improved and none progressed (0%).

Conclusion

A combination of bracing and PSSE can effectively treat AIS, according to SRS inclusion criteria. 88.5% of patients did not progress more than 5o and only 6.4% overpassed surgical indication range. IBC and compliance are the most important prognostic factors for successful treatment result. Our multi-professional approach probably enhanced adherence to treatment protocol. Future randomized controlled studies, with brace and PSSE, are recommended to provide stronger scientific evidence.

Abstract : # 114

List of Authors

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Title

Adult Spinal Deformity: functional improvement after non-operative treatment? Results from an interdisciplinary bio-psycho-social intervention

Background

The prevalence of adult spinal deformity (ASD) is increasing. Currently, no evidence based treatment exists for ASD patients with chronic low back pain (CLBP). An interdisciplinary intensive combined physical and psychological programme (CPPP) has been validated and proven to be effective for patients with CLBP. The aim of this study is to evaluate the outcomes of this CPPP for ASD patients with CLBP and compare the treatment outcomes with a non-ASD cohort (CLBP patients without ASD).

Method(s)

Prospectively collected data of an ASD cohort (n=80) was selected from the database with data on consecutive patients who completed the CPPP. Main inclusion criteria: no indication for surgery or invasive pain treatment, Cobb angle >10°. Exclusion criteria: involvement in compensation claims and primary psychiatric disorders. A non-ASD cohort (n=240) was matched based on age and gender. Primary outcome: functional status (ODIv2.1a). Secondary outcomes: pain intensity (NPRS 0-100), self-efficacy (PSEQ) and quality of life (SF36-PCS; SF36-MCS). Assessments: pre and post treatment, 1- and 12-month follow-up (FU). Clinical relevance: minimal important clinical change (MCIC; ODI 10 points), patient acceptable symptom state (PASS; ODI≤22).

Results

Demographics ASD cohort: 79% female, mean age 50.9 (±14.1) years, mean CLBP duration 15.5 (±12.5) years, mean Cobb angle 21.4 (±9.4)°. The matched non-ASD cohort did not differ in demographics. Both cohorts improved in functional status ($F[1,318]=142.982$, $p<.001$; $r= 0.31$).The ASD cohort improved from mean ODI 39.5(±12.0) at baseline to mean ODI 31.8(±16.5) at 1-year FU. Clinical relevance: 51% of the ASD patients reached MCIC and 33% reached a PASS. A significant interaction effect is shown between time and both cohorts ($F[1,318]=8.2$, $p=.004$; $r= 0.03$), however not clinically relevant. All secondary outcomes followed a similar pattern: improvement at 1-year FU.

Conclusion

To our knowledge this is the first study showing beneficial outcomes of a non-operative treatment in selected ASD patients with longstanding CLBP. The CPPP achieves improvement in terms of functional status, pain, and quality of life for ASD patients for whom surgery is not an option. This could help diminish the increasing burden of ASD for patients and healthcare utilization and costs.

Abstract : # 115

List of Authors

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Title

Differences in sagittal spinal profile precede the development of scoliosis; the relevance of the Posteriorly Inclined Triangle Surface (PITS)

Background

The importance of the individual spinal sagittal profile in development and progression of idiopathic scoliosis has been recognized for over a century. Recently, a more posteriorly inclined spinal segment at the apical regions in mild scoliosis patients was observed compared to controls. Unfortunately, prospectively studying the general population for scoliosis development remains limited since the small prevalence requires an enormous sample size, which disqualifies ionizing imaging techniques. Therefore it is unknown if specific sagittal spinal profile types precede the development of idiopathic scoliosis. We prospectively studied a 22q11.2 deletion syndrome (22q) population, with an idiopathic-like scoliosis prevalence of ~50%, to test our hypothesis that already years before scoliosis onset, the sagittal spinal profile already differs between those that will and will-not develop scoliosis later on.

Method(s)

At the national center for pediatric 22q, patients are follow-up at a multidisciplinary outpatient clinic from first diagnosis until adulthood. From age 6, all 22q patients are screened for orthopedic manifestations every ~2 years including standard spinal radiography. In this study, all patients without scoliosis at the initial visit and a minimum follow-up of 2 years were included. The posteriorly inclined triangle surface (PITS) and other parameters were measured on lateral spinal radiographs at inclusion. At latest follow-up the coronal Cobb angle was measured to determine if scoliosis (Cobb >10°) had developed.

Results

57 patients were included with a mean age of 9.5±2.3, the median follow-up was 3.5 years and at latest follow-up 22 out of 57 had developed scoliosis (39%), of which 10 thoracic and 12 (thoraco)lumbar. The PITS was 73±39cm2 in the thoracic scoliosis group and 74±29cm2 in the (thoraco)lumbar group, significantly larger than 42±26cm2 in the group that had not developed scoliosis ($p<0.01$). Furthermore, a larger pelvic incidence was observed in the (thoraco)lumbar group compared to both thoracic scoliosis and controls, and the PITS-shape was steeper in thoracic scoliosis compared to elongated in (thoraco)lumbar scoliosis.

Conclusion

A larger sagittal profile parameter 'PITS' in the asymptomatic spine precedes scoliosis development in a prospective cohort. Sagittal spinal shape before curve onset, dictated in part by pelvic morphology, predisposes for curve type if scoliosis potentially develops.

Abstract : # 118

List of Authors

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Title

Spinal Intradural Extramedullary Schwannoma Simulating Thoracic Scoliosis

Background

Along with neuromuscular or congenital conditions, still, the cause of most scoliosis patients remains unknown, causing these cases to be defined as idiopathic deformities. A real challenge for clinicians is to clarify truly idiopathic cases from those caused by rare and uncommon conditions, often leading to late or misdiagnosis. Spinal tumours, particularly schwannomas have insidious natural history and can mimic the onset of spinal deformity in adolescents.

Case Description:

We present the case of a 13-year-old boy, who had a 6-month history of orthopaedic and neurologic problems and was diagnosed with non-specific thoracic dextroscoliosis (Cobb angle – thoracic 20°, lumbar 10°). Initial conservative treatment, including physiotherapy, was prescribed without significant improvement for 6-months, during the last 2 weeks of which he also used a corset for 2h a day. Instead, there was further development of neurological symptoms such as muscle weakness, tremor, dysesthesias. Orthotic treatment was strengthened. A specific cause was not yet suspected. Pharmacotherapy for pain and muscle stiffness was also included. One month later rapid progression of symptoms including increasing signs of lower paraparesis was reason for spinal surgeon attendance and an urgent MRI was performed, identifying a benign extramedullary process in the spinal cord (Th5-6 level) causing cord compression. Laminoplasty Th4-Th6) and complete tumour extirpation was performed immediately, yielding quick results. The obtained biopsy material confirmed a schwannoma. At follow-ups 3 months and 12 months later, there was considerable clinical and radiological improvement. Neurologic deficits have disappeared completely, only minor postural asymmetry was noted. Rehabilitation course was administered to correct posture and regain strength in his back muscles.

Conclusion

One of the key goals of scoliosis assessment is to identify the aetiology of deformity, considering also uncommon causes. Regular follow-ups might help in reassessing an initially idiopathic scoliosis case. Any objective sensory or motor neurological deficit must be investigated as it can be a clear clue to certain diagnoses.

Abstract : # 119

List of Authors

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Title

Back pain in patients with idiopathic scoliosis is not driven by commonly known genetic variants associated with pain but by other factors

Background

Idiopathic scoliosis (IS) is the most common type of spinal deformity in children and adolescents and is a risk factor for back pain. Low back pain is the leading cause of disability worldwide. Some genetic variants have been associated with back pain. The aim of this study is to evaluate genetic variants associated with pain in IS patients.

Method(s)

1447 individuals (1267 females) with juvenile or adolescent IS from Sweden and Denmark were included in the study. Single nucleotide polymorphism (SNP) genotyping was performed for 5 genetic variants previously reported to be associated with pain. Data for the pain domains of the Scoliosis Research Society 22 revised questionnaire (SRS-22r) ranging between 1; severe pain, and 5; pain-free, and the EQ-5D 3-level version were collected. The individuals were dichotomized according to the SRS-22r pain domain (<4 or >4) or the EQ-5D pain domain as having no pain/discomfort vs moderate or extreme pain/discomfort. Statistical analysis was performed using case-control association, chi-squared and t-tests, and statistical significance set to $p<0.05$.

Results

457 individuals (31%) had an SRS-22r pain domain score of less than 4. 815 (56%) individuals had moderate or extreme pain/discomfort according to the EQ-5D pain domain. No statistically significant differences for the dichotomized SRS-22r pain domain or EQ-5D pain domain could be found for the genetic variants rs4680 (p=0.801, p=0.885), rs6795970 (p=0.181, p=0.803), rs6746030 (p=0.707, p=0.878), rs3180 (0.605, p=0.240), or rs781494 (p=0.946, 0.117). 184 (35%) of the 524 surgically treated individuals had SRS-22r pain domain <4 vs 272 (30%) of the 922 non-surgically treated individuals (p=0.026). 735 (58%) of 1266 females reported moderate or severe pain/discomfort on EQ-5D vs 80 (45%) of 179 males (p=0.001). No statistically significant differences for the dichotomized SRS-22r or EQ-5D pain domains were found between Danish and Swedish patients, type of IS, convexity, or ancestry.

ConclusionIn our cohort of idiopathic scoliosis individuals, no association was found between individuals with back pain and without back pain for five previously reported genetic variants associated with pain. This data illustrates that back pain in idiopathic scoliosis is not driven by commonly known pain genetic variants, but by other factors.

Abstract : # 120

List of Authors

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Title

Spine surgery in patients with meningomyelocele; comorbidities, curve correction, complication rate and risk. A study of 30 patients treated for at the University Hospital of Uppsala.

Background

The benefits and timing of Spinal correction surgery in patients with meningomyelocele (MMC) is an ongoing discussion among physicians. This is a retrospective study of 30 MMC cases that were surgically treated with spinal deformity correction at the University Hospital of Uppsala in Sweden.

Method(s)

Data on 30 MMC cases from 2008 to 2020 were collected from the patient journal, the hospital's radiology database and the Swedish spine registry. Pre- and post-correction cobb angles were measured in the anteroposterior or lateral x-rays. We tested weather perioperative bleeding correlated with the operative method (correction with or without osteotomy) or infection.

Results

There were 21 males and 9 females (7:3), average age at surgery was 9.6 years (range 1-16, SD=±3.8). 21 out of 30 patients had type 2 Chiari malformation, only 2/30 could walk independently, while 6/30 had partially preserved neurology but were not ambulatory. 18 patients received a growing spinal instrument at the primary operation, 12 received definitive fixation. Most of the curves were corrected without an osteotomy (21 vs 9). Mean correction was 45.77 (±38.02) degrees for thoracic, 50.17 (±11.57) for lumbar, and 43.00 (±19.04) for thoracolumbar curves. The number of major reoperations (i.e. all reoperations excluding planned elongations and VAC-changes) was 36 (n=30 patients). 6/30 developed deep infection that required secondary surgeries, four patients (23.3%) had accidental dural tear (n=16). Patients that received a growing system underwent a significantly increased number of major reoperations compared to patients operated with final fusion (p=0,015) and patients suffered from a complication that led to early surgery (< 3 months) underwent a significantly increased number of major reoperations compared to the rest of the patients (p=0,021). Osteotomy or VCR was not associated to the amount of perioperative blood loss, nor the number of major reoperations.

Conclusion

Operative treatment of spinal deformities in this patient group entails increased risk for complications, especially deep surgical site infections. Instrumentation with growing rod systems was correlated with increased risk for reoperation while osteotomies did not affect the amount of bleeding. It is recommended that the surgeon, if possible, opt for definitive fixation over growing systems.

Abstract : # 122

List of Authors

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Title

Finite element comparison of the Spring Distraction System and the Traditional Growing Rod for the treatment of Early Onset Scoliosis.

Background

"Growth-friendly" implants that require periodic lengthenings, such as the Traditional Growing Rod (TGR) show high rates of implant failure, stiffening of the spine, and intervertebral disc (IVD) height loss. We developed the Spring Distraction System (SDS), which employs continuous dynamic spring forces, theoretically circumventing these limitations. The current finite element (FE) study simulates and compares TGR and SDS implantation, followed by an 18-month growth period to determine differences between both strategies.

Method(s)

A representative, ligamentous, scoliotic FE model was created. Two versions of the same model were created; a TGR version (fixed side-to-side connectors) and an SDS version (sliding connectors and bilateral 75N springs). The inferior endplate of S1 was fixed in all degrees of freedom. In the TGR model, initial implantation and subsequent follower load (simulating the effect of gravity and muscle forces) were modeled. The models then simulated 18 months of epiphyseal spinal growth using coding based on the Hueter-Volkmann principle. While the SDS continually distracted over this period with attenuating spring forces, for the TGR model, two additional distractions following index surgery were modeled (at 6 and 12 months). Outcomes included rod von Mises stress (VMS) magnitude, and differences in stress-shielding of the IVD between both models.

Results

Maximum VMS post-operatively was 249 MPa for SDS and 205 MPa for TGR. However, with each TGR distraction, maximum VMS in all TGR rods increased over 2-fold to a maximum VMS of 417 MPa, compared to 262MPa in the SDS model at 6 month follow-up. VMS remained consistently higher than those in the SDS model. At 12- and 18 month follow-up, there was much less stress-shielding of the IVDs in the SDS model compared to the TGR model. Mean compressive forces on the upper IVD faces of the SDS model were 112±19N higher compared to their TGR counterparts. For the lower IVD faces, the mean difference was 100±17N.

Conclusion

Intermittent lengthenings in TGR treatment lead to increased VMS in the implanted rods compared to continuous SDS treatment. In addition, the intermittent lengthenings lead to increased stress-shielding of the IVD, which may adversely affect IVD health.

Abstract : # 124

List of Authors

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Title

The effectiveness of different concepts of bracing in Adolescent Idiopathic Scoliosis (AIS): a systematic review and meta-analysis.

Background

AIS mostly progress during adolescent and brace therapy is generally applied to prevent progression of the curve. Multiple concepts of bracing have been developed, however it is currently not fully known whether there is a difference in effectiveness.

The primary aim is to compare the effectiveness of the different brace concepts. Effectiveness is defined as the effect on curve magnitude and/or prevention of the need of surgery

Method(s)

This systematic review and meta-analysis was performed according to the PRISMA statement. All original studies on brace treatment for AIS were systematically searched for in PubMed and EMBASE up to December 2019. Articles that did not report on any maturity parameter of the study population were excluded. Critical appraisal was performed using MINORS. Brace concepts were distinguished based on prescribed wearing time and rigidity of the brace: full-time, part-time and night-time, rigid braces and soft braces. In the meta-analysis, success was defined as ≤5° curve progression during follow-up, and success rates were compared to untreated scoliosis patients.

Results

33 out of 2609 articles were included. 12 papers had high risk of bias and 6 did not report success as ≤5° curve progression. Rigid full-time brace had on average a success rate of 73.2%, night-time of 78.7%, soft braces of 62.4%, observation only of 50%. There was insufficient evidence on part-time, rigid braces for the meta-analysis.

Conclusion

12 out of 33 studies focusing bracing of AIS have significant risk of bias. No difference between the night-time, or full-time concepts could be identified. Soft braces have a lower success rate compared to rigid braces.

Abstract : # 126

List of Authors

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Title

Early soft tissue adaptation to spring distraction for Early Onset Scoliosis.

Background

To treat early onset scoliosis (EOS), we developed the Spring Distraction System (SDS), a dynamic growth-friendly implant that continuously exerts dynamic distraction forces through a titanium helical spring placed over a standard sliding rod. Different spring configurations are used to treat different curves. While springs are fully compressed during implantation, in first erect radiographs, spring expansion is often observed, as a result of soft tissues creep. The aim of this study was to quantify this soft tissue effect.

Method(s)

In this single-center retrospective analysis 45 consecutive EOS patients received the SDS. In all patients, the post-operative spring length at the first erect radiograph was measured by two observers using a freehand method on coronal and sagittal x-rays.

Results

Forty-five SDS patients (13 congenital, 7 idiopathic, 20 neuromuscular and 5 syndromic) with a mean age of 8.6±2.2 years at surgery had a first post-operative radiograph after 5.3±4.2 days. Ninety-nine springs were implanted with the following configurations: 50 N with a 0.67 N/mm spring rate (n=1), 75 N with a 2.15 N/mm spring rate (n=90) and 100 N with a 1.33 N/mm spring rate (n=8). At the first erect post-operative radiograph, in 39 (87%) patients one or more springs had expanded. This was different for different types of scoliosis: 0.7±1.7 mm in more rigid congenital patients, 5.5±2.0 mm in idiopathic patients, 6.6±6.1 mm and 5.7±6.5 in neuromuscular patients and 6.9±11.2 mm in syndromic patients. Patients primarily treated with the SDS showed 4.7±4.6 and 0.8±1.6 spring expansion on the concavity and convexity respectively. In patients treated with a magnetically controlled or traditional growing rod prior to SDS treatment spring expansion was 7.4±6.1 and 3.5±5.7 mm. Although expansion improved correction, the growth-capacity of the concave and convex 50 N, 75 N and 100 N springs was reduced by respectively 15% and 0%, 15% and 16%, 10% and 10%.

Conclusion

This analysis indicates that dynamic distraction leads to immediate soft tissue creep in the first days after surgery. This effect is desirable, but should be accounted for especially with respect to allowing sufficient length for growth. How to anticipate on this effect will be subject on future studies.

Abstract : # 127

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Title

Short term pain recovery after idiopathic scoliosis surgery

Background

Surgery for idiopathic scoliosis is extensive and associated with severe pain. Pain management is paramount for early recovery and shortened hospital stays. Our aim was to describe short term pain recovery after the hospital stay in a consecutive cohort of patients undergoing fusion surgery.

Method(s)

30 patients (22 females) undergoing surgery for idiopathic scoliosis between ages 11 and 21 were recruited. All took part in an ongoing randomized controlled trial comparing drain and no drain regimes. Questionnaire for assessment of visual analogue scale (VAS) back pain (0; no pain, to 10; worst possible pain) and the SRS-24 pain domain (1; worst, to 5; best) were collected preoperative, 2 weeks, 6 weeks and 12 weeks postoperative and answered by 26 to 30 of the individuals at the different time points. Mean change and corresponding 95% confidence intervals are presented.

Results

Mean (SD) age at surgery was 15.6 (2.5) years. Preoperative mean SRS-24 pain domain was 3.3 (0.7) and VAS back pain 3.5 (2.8). Mean change of the SRS-24 pain domain compared to preoperative was at 2 weeks -0.5 (-0.2 to -0.9), at 6 weeks 0.2 (0.7 to -0.2), and at 12 weeks 0.7 (1.2 to 0.3). Mean change of VAS back pain compared to preoperative was at 2 weeks 2.2 (1.0 to 3.5), at 6 weeks -0.4 (-1.5 to 0.7) and at 12 weeks -0.9 (-2.2 to 0.4).

Conclusion

Pain intensity after scoliosis surgery diminishes after a few weeks and approaches preoperative levels 6 to 12 weeks after surgery.