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CASE REPORT / CASE SERIES

Treatment Outcomes among Pediatric Patients with Cervical Pott's Disease in a Tertiary Care Center: A Case Series

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ABSTRACT

Tuberculosis remains a perennial global problem despite advances in detection and treatment. Apart from the pulmonary system, it can also affect the spine of both adult and pediatric patients, with a predilection for the thoracic and lumbar spine. Rarely does spinal TB or Pott's disease affect the cervical spine and there are few high-level studies in the pediatric population.

Variations are the following: Atlantoaxial/Upper Cervical TB (AATB), Subaxial Cervical TB (SACTB), and Cervicothoracic TB (CTTB). Motor and sensory deficits are more common in CTTB and some SACTB patients while myelopathic signs predominate in AATB patients. The mainstay of treatment for pediatric cervical TB is still anti-tubercular treatment (ATT) using anti-Koch's medication depending on the level of drug resistance. For some patients, surgery may be indicated with CTTB having the lowest threshold because of its anatomic location. Most patients improve after a year of treatment with at least a 1 Frankel letter grade improvement.

Keywords. pediatric, Pott's disease, cervical spine, spinal tuberculosis

INTRODUCTION

Tuberculosis is a global concern that affects both developed and underdeveloped countries. Globally, it is the 13th leading cause of death and the second in terms of infectious disease killers behind COVID-19 despite improvements in detection and treatment. It can affect people of all age groups with most cases being adults. In addition to this, mortality rates are highest in low- and middle-income countries.[1] Unfortunately, the Philippines falls under this category as stated by the Organization for Economic Cooperation and Development (OECD). Furthermore, the Philippines is one of the high-burden countries that account for 80% of TB cases worldwide.[2]

Despite the rise in treatment rates, a fraction of the population still progresses to Extra-Pulmonary TB. This refers to any bacteriologically confirmed or clinically diagnosed case of TB involving organs other than the lungs. When it involves two or more non-contiguous sites it is referred to as Disseminated TB. In 2015, the Philippine General Hospital TB Directly Observed Treatment Short Course (PGH TB-DOTS) Center reported that their Disseminated TB patients had a mean age of 33.97 years old, none of whom were pediatric patients. In terms of location, the pulmonary system had the highest concentration of cases followed by the intestinal system (32%) and the spine (27%).[3]

Spinal TB or Pott's disease was discovered as early as the 1700s by Sir Percival Pott; he described a tuberculous spondylitis

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Table 1. Description, stages, and treatment for Atlantoaxial/Craniovertebral TB (AATB)[8]

Stage	Description	Recommended treatment	Additional remarks
I	• Unilateral involvement of the facet of the atlas • No destructive deformation • No neurologic deficits	Medical treatment (ATT)	May or may not involve long-term rigid orthosis application
II	• Involvement of atlantoaxial joint by destructive necrosis and inflammation • May involve parts of the axis • Presence of neck pain, neck muscle spasm, and severe restriction of neck movements • Torticollis may be present • Patient may or may not have neurologic deficits	Medical treatment (ATT) Surgical Management	Posterior approach • Preferred approach globally • Atlantoaxial fusion - Reducible AA dislocation • Occipitocervical fusion - Occipitoatlantial joint involvement - Bilateral AA joint destruction
III	• Involvement of the atlantoaxial joint as well as other bones and joints in the region • Evidence of instability noted • Patients have neurologic deficits		Combined Anterior- Posterior (Intra or Pre-Operative Halo distraction if needed) • Irreducible AA dislocation • Rotatory AA dislocation Anterior approach alone – does not provide biomechanically robust options for stabilization

ATT = anti-tubercular treatment; AA = Atlantoaxial

presenting as paraplegia in patients with kyphotic deformities.[4] It more commonly affects the thoracic and lumbar areas while rarely affecting the cervical and sacral areas. For diagnosed Category I cases, anti-tubercular treatment (ATT) lasts for 6 months while for Category IA cases (Extra-pulmonary TB of meninges, bones, or joints), treatment lasts for 1 year.[5] Although most patients can be managed medically, some will require surgical treatment on top of ATT.[4]

The Frankel Grading System is used to classify a patient's deficits. Patients are scored from A to E (with A being the worst and E the best indicating no deficits).[6,7] Cervical TB is also classified according to location: Atlantoaxial/Upper Cervical (AATB) from C1–C2, Subaxial Cervical (SACTB) from C3–C6, or Cervicothoracic (CTTB) from C7–T2.

AATB is usually treated medically only, except when there are extensive neurologic deficits and/or radiologic destruction. Patients in the 2nd or 3rd stages of AATB usually benefit from surgery (Table 1).[8]

For SACTB, a grading system helps determine whether patients need surgery on top of ATT (Table 2).[9,10] Grade 2 (5-6) patients require surgery via an anterior approach, and grade 3 (7-8) patients require surgery via a combined posterior and anterior approach. Despite this grading system, the anterior approach is preferred for SACTB. This is because of its direct approach to diseased vertebra, better disease clearance, spinal decompression, robust stabilization, ameliorated reconstruction, fusion, and better lordosis restoration. The posterior approach on the other hand is indicated for pan-vertebral disease (multi-level), posterior-only involvement, significant kyphosis/sagittal imbalance, long-segment disease needing corpectomies at more than two levels, and compression from vertebral elements lying posterior to the cord.[9] For SACTB patients with no MRI available, parameters that warrant surgery include progressive deterioration of neurologic function, serious deformity such as kyphosis at diagnosis (C2–C7 lordosis of >0 degrees or SVA >4 cm), deterioration of neurologic function after 1 week of ATT.[11]

The cervicothoracic junction represents a transitional zone between the rigid kyphotic and mobile lordotic spinal segments. These enhanced biomechanical stresses predispose it to developing progressive kyphosis and instability. Approaches to this area include Anterior only, Anterior and Posterior, or Posterior only (Table 3).[12]

While Rajasekaran's "spine at risk" signs have been used to guide the decision for surgery in pediatric patients, these were studied only in the thoracic and lumbar levels in pediatric patients 15 years old and younger.[4]

Table 2. Xiangya Institute of Medical Sciences Cervical Tuberculosis grading system[9]

Parameter	Score
Restriction of active neck movement	
No	1
Yes	2
Motor power	
No	1
Minimal (Motor power ≥4)	2
Severe (Motor power ≤3)	3
Radiologic features	
Paravertebral collection (C7 anteroposterior diameter) without evidence of bone destruction or radiological instability	1
Paravertebral collection, evidence of bone destruction (involvement of one vertebral column in the Denis System)[10], thecal sac compression without cord compression, or cord changes	2
Severe bone destruction (involvement of 1 vertebral column in the Denis system)[10] with cord compression and/or cord signal changes	3

Table 3. Surgical approaches for Cervicothoracic Spinal TB (CTTB) and indications[12]

Anterior only	• Single-segment lesion • Infection and destruction confined to anterior column with abscess/necrotic tissue compressing the front of the spinal cord • Mild kyphosis deformity less than 30 degrees
Anterior and Posterior	• Multi-segment lesions • Severe destruction • Complex kyphotic deformity greater than 50 degrees
Posterior only	• Moderate kyphotic deformity less than 50 degrees • Presence of significant vertebral collapse caused by bone destruction or multicentric TB spondylitis • One or two segment involvement with lesions accessible through a posterior approach • Spinal cord compression caused by paravertebral/epidural abscess • Severe or progressive neurological dysfunction and persistent lower neck pain unresponsive to conventional therapy • Elderly patients with complicated co-morbidities intolerant of extreme surgical intervention

Clinically, 43% of pediatric patients with TB present with neck pain and cervical involvement.[13] Their deformities, unfortunately, are worsened by the growth retardation of the anterior column and unrestricted growth of the posterior column.[14] A higher red bone marrow content and richer peripheral blood supply also hasten the spread of *Mycobacteria Tuberculosis*; there is a 66.7 % chance of consecutive vertebra involvement, 23.8% chance of single vertebra involvement, and a 9.5% chance of non-consecutive multiple vertebral body involvement.[13]

Given the increasing prevalence and disastrous consequences of pediatric cervical Pott's disease, we aimed to expand the body of knowledge in this field.

METHODOLOGY

Setting and study population

From January 2020 to January 2023, data was collected from Pediatric patients diagnosed with cervical Pott's disease (Upper Cervical/Atlantoaxial, Subaxial Cervical, Cervicothoracic) in a single institution. All included patients were histopathologically or microbiologically diagnosed with Pott's Disease. None of the patients had documented drug resistance and were compliant with ATT up to the final follow-up of at least one year. Adults and patients with T3-S5 involvement were excluded.

Types of interventions

Patients were managed medically or surgically. All patients received ATT. Medically managed patients received: 1) external immobilization, and/or 2) minimally invasive image-guided aspiration. Surgically managed patients underwent either: 1) decompression with or without instrumentation, or 2) open biopsy with or without immobilization.

Methods of instrumentation were the following: occipito-cervical fusion with screws and rods, fusion with lateral mass screws and rods, or anterior discectomy and fusion. External immobilization methods were: Halo vest for AATB, Philadelphia/Miami J collar for SACTB, and Cervico-thoracic Orthosis for CTTB.

Main and secondary outcomes

Outcomes monitored for the patients included: Frankel grade, Modified Japanese Orthopaedic Association scale (mJOA) improvement, and complications (implant failure or surgical site infections).

Frankel grade improvement was documented by assigning the following values:

- Frankel A: 1
- Frankel B: 2
- Frankel C: 3
- Frankel D: 4
- Frankel E with myelopathic signs: 5
- Frankel E without myelopathic signs: 6

The Frankel grade improvement was then calculated as the difference between the value at the last follow-up and the initial assessment.

Informed consent

Except for patient # 9 who dropped out from the study, informed consent was obtained from all patients either during the study or on the final follow-up of 1 year. The adult relative gave consent for patients below 18 years of age. Patients were updated on the progress of the manuscript as well as the intention of the authors to submit it for publication. All patients who had signs of Myelopathy were contacted at a later date from the latest follow-up to obtain final mJOA scores. Patients 6, 10, and 11 were evaluated face-to-face while patients 5 and 7 were evaluated via call.

RESULTS

Information obtained included: age, sex, area of pathology, date of first consult and Frankel grade, date of follow-up between 3 months to 1 year and Frankel grade, date of last follow-up and Frankel grade, mJOA on first consult for patients with signs of myelopathy, mJOA on last follow- up, spine diagnosis, other areas of disseminated TB, comorbids, procedure/s performed, and type of immobilization if applicable (Table 4).

Eleven pediatric patients from January 2021 to January 2023 were included with a mean age of 12. The atlantoaxial spine was the most involved cervical spine segment.

Table 4. Database of patients with cervical Pott's disease

Patient #	Age/ Sex	Levels affected	Diagnosis/ Presentation	Frankel Grade (First Consult)	Frankel Grade (3 - 6 month follow-up)	Frankel Grade (minimum 1 year follow-up)	Intervention/ Treatment
1	14/M	Subaxial (C6-C7)	Paraplegia LN C6 / Nape pain	Frankel B	Frankel C (3 months)	Frankel E	Medical CT-guided aspiration biopsy application of orthosis
2	7/M	Cervico-thoracic (T1)	Paraplegia LN T1 / Neck pain	Frankel C	Frankel E (3 months)	Frankel E	Medical
3	13/M	Subaxial (C5-C6)	Paraparesis LN C4 / Neck pain	Frankel D	Frankel E (6 months)	Frankel E	Surgical Laminectomy C4-C6, open biopsy Philadelphia collar
4	12/M	Cervico-thoracic (C7)	Paraplegia LN T2 / Neck pain	Frankel B	Frankel C (6 months)	Frankel C	Medical Refused surgical treatment during the first consult, referred back due to admission for a medical problem
5	14/M	Upper cervical (C2-C4)	Neck pain from cervical instability secondary to Pott's Disease	Frankel E Myelopathic hand signs (mJOA 15)	Frankel E (5 months)	Frankel E (mJOA 17)	Medical Application of halo vest
6	12/F	Upper cervical (C1- C2)	Neck pain from cervical instability secondary to Pott's disease	Frankel E Myelopathic hand signs (mJOA 12)	Frankel E (3 months)	Frankel E (mJOA 15)	Surgical Occipitocervical fusion
7	16/M	Upper cervical (C1- C2)	Neck pain from cervical instability (Odontoid migration) Pre-vertebral abscess	Frankel E Myelopathic hand signs (mJOA 11)	Frankel E (6 months)	Frankel E (mJOA 16)	Surgical Occipitocervical fusion
8	16/F	Subaxial (C5)	Cervical radiculopathy	Frankel D	Frankel E (5 months)	Frankel E	Surgical Anterior cervical discectomy and fusion
*9**	3/M	Cervico-thoracic (C7-T1)	Quadriparesis LN C5 Tuberculous arthritis, left hip	Frankel C	Opted to transfer back to the previous hospital	N/A	Medical Debridement, arthrotomy, left hip (Previous hospital)
10	18/F	Subaxial (C2-C3)	Cervical myelopathy	Frankel D myelopathic hand signs (mJOA 14)	Frankel E (3 months)	Frankel E (mJOA 17)	Medical Transoral drainage (ORL-HNS) orthosis application
11	9/M	Upper cervical (C2)	Cervical myelopathy	Frankel E myelopathic hand signs (mJOA 16)	Frankel E (6 months)	Frankel E (mJOA 17)	Medical

All patients received anti-tubercular treatment (ATT)
*drop-out/lost to follow-up; LN = last normal level; mJOA = Modified Japanese Orthopaedic Association scale; ORL-HNS = Otorhinolaryngology-Head and Neck Service

Four patients were managed surgically for varying indications; these were radiologic instability, progressive neurologic deficit, draining sinus, or enlarging abscess. One drop-out was noted due to their decision to transfer to their hospital of choice (#9). Four AATB patients (#5, #6, #7, #11) initially presented with Frankel E grades and myelopathic signs that improved after treatment. Despite the refusal of two patients (#1 and #2) to proceed with surgery, Frankel grade improvement was documented despite persistent deformity.

Among patients who presented with neurologic deficits, there was an improvement of at least one Frankel letter grade with a mean value of 1.8. Surgically managed patients improved by a mean Frankel grade of 1.67 while medically managed patients improved by a mean of 1.86. All myelopathic symptoms also resolved.

There was a weak negative correlation [Pearson R = -0.15)] between age and area of pathology and a positive correlation (R = 0.85) between initial Frankel grade and area of pathology. AATB patients are less likely to present with motor or sensory deficits as compared to SACTB and CTTB patients.

CASE DISCUSSION

Patient #1

A 14-year-old male with a 4-month history of nape pain [numerical rating scale score (NRS) of 6/10], weight loss, and night sweats, with neck stiffness and bilateral lower extremity weakness [Last normal level (LN) = C5], with sacral sparing.

Imaging showed a retropharyngeal abscess and gibbus deformity at the cervicothoracic junction. The retropharyngeal abscess was aspirated, and a brace was applied since he and his parent did not consent to surgery (Figure 1A and B). The focal kyphosis of 32 (Figure 1E and F) degrees could have benefitted from a posterior-only approach. Apart from this, ATT was completed. The patient recovered one year after initiation of treatment based on the Frankel grade but deformity persisted at 32 degrees (Figure 1C) with occasional pain.

Patient #2

A 7-year-old male presented with a 3-month history of neck pain (NRS 5/10) and gradual onset bilateral lower extremity weakness (Figure 2A, C, and Figure 3). Physical examination showed normal motor and sensory levels at T1. After one year of ATT, Frankel grade improvement was seen on reevaluation despite the patient having a kyphosis between 30 and 50 degrees (Figures 2B and D).

Like Patient #1, a posterior approach could have been beneficial to correct the patient's deformity but again no consent could be obtained.

Patient #3

A 13-year-old male presented with a 1-month history of dull, aching neck pain (NRS 7/10) and weakness of both upper and lower extremities, and a 2-week history of myelopathic signs. Physical examination upon admission showed weakness of both upper extremities (4/5) and lower extremities (3/5) and the presence of inverted radial reflexes and Hoffman signs.

Imaging studies showed an enlarging abscess posterior to the vertebral bodies of the subaxial cervical spine with no radiologic instability (Figure 4A-E). Open drainage of the abscess was done (Figure 4F). Subsequently, the patient underwent external immobilization and initiation of ATT. He had Frankel grade improvement upon follow-up.

This patient had a SACTB score of 5 (Grade 2) for which the anterior approach is recommended. The open biopsy and drainage were done via the posterior approach instead for the following reasons: pan-vertebral disease (multi-level), posterior-only involvement, and canal compromise due to compression from vertebral elements lying posterior to the cord.

Patient #4

A 12-year-old male presented with a 4-month history of neck pain with no associated signs and symptoms and a 3-month history of worsening neck pain and both lower extremity weakness. Physical examination showed motor and sensory deficits (LN T3) and hyperreflexia on both knee and Achilles tendon deep tendon reflexes.

Given the progression of symptoms, kyphosis of >50 degrees, and severe destruction causing lateral translation, the patient was advised to undergo surgery (Figure 5A and C). The patient and his family refused surgery but were willing to undergo ATT. The patient was initially lost to follow-up but at 1 year post-treatment, was readmitted for a different complaint by another service and was subsequently referred to Ortho. Repeat radiographs showed no improvement in the thoracic spine (Figure 5B and D) and a 1-letter Frankel grade improvement. Any further surgical interventions were still refused.

Table 5. Frankel grade improvement

Patient #	Frankel (Initial)	Frankel Grade (Latest Follow-up)	Grade Improvement
1	B	E	4
2	C	E	3
3*	D	E	2
4	B	C	1
5	E with Myelopathy	E	1
6*	E with Myelopathy	E	1
7*	E with Myelopathy	E	1
8*	D	E	2
9 **	C	THOC	N/A
10	D	E	2
11	E with Myelopathy	E	1
Mean			1.8
Mean (Surgical)	1.67	Mean (Non- Surgical)	1.86

All patients received anti-tubercular treatment (ATT)
*surgically managed; **drop-out/lost to follow-up; THOC = To Hospital Of Choice

Patient #5

A 14-year-old male presented with a 2-month history of gradual onset neck pain (highest NRS at 8/10) with associated gait difficulties and paresthesia of both upper extremities. Physical examination showed no motor and sensory deficits but with hyperreflexia on biceps and triceps deep tendon reflexes, and inverted radial reflexes. Radiographs showed involvement of the C2–C4 vertebrae (Figure 6A, C, E-H). A halo vest was applied to address the instability (Figure 6B and D).

Given the involvement from C2-C4, both the AATB classification by Goel et al. and the SACTB classification by Wang et al. can be used.[8] Since he is classified as AATB Grade I and SACTB Grade 4, while surgery is not warranted, an orthosis may be applied. The focal kyphosis resulting from

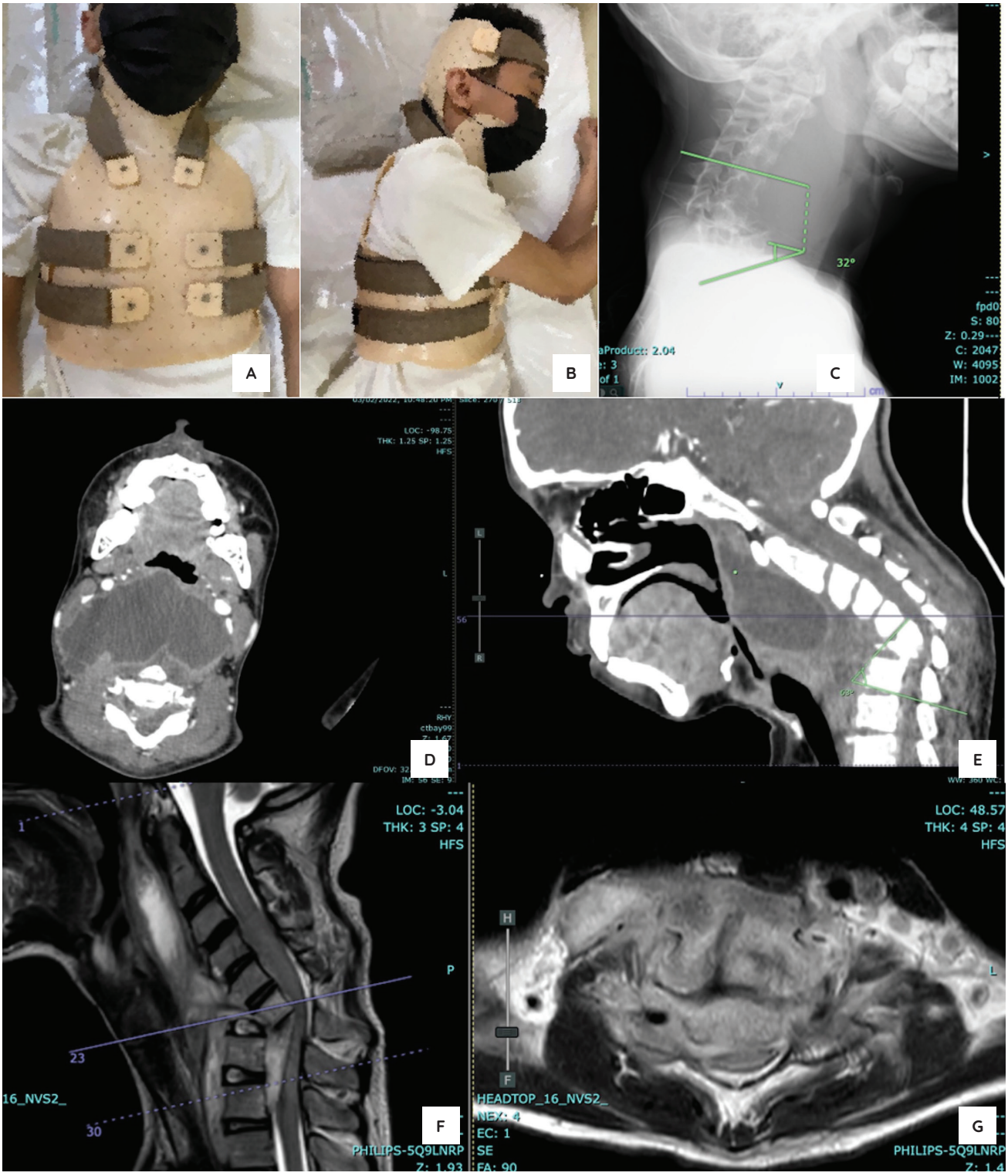

Figure 1. Patient 1 Imaging studies and clinical images. **(A and B)** Clinical pictures on follow-up. **(C)** latest radiograph on 1 year follow-up. **(D and E)** Pre- treatment CT- Scans. **(F and G)** Pre- treatment representative MRI cuts (T2- weighted sagittal and axial).

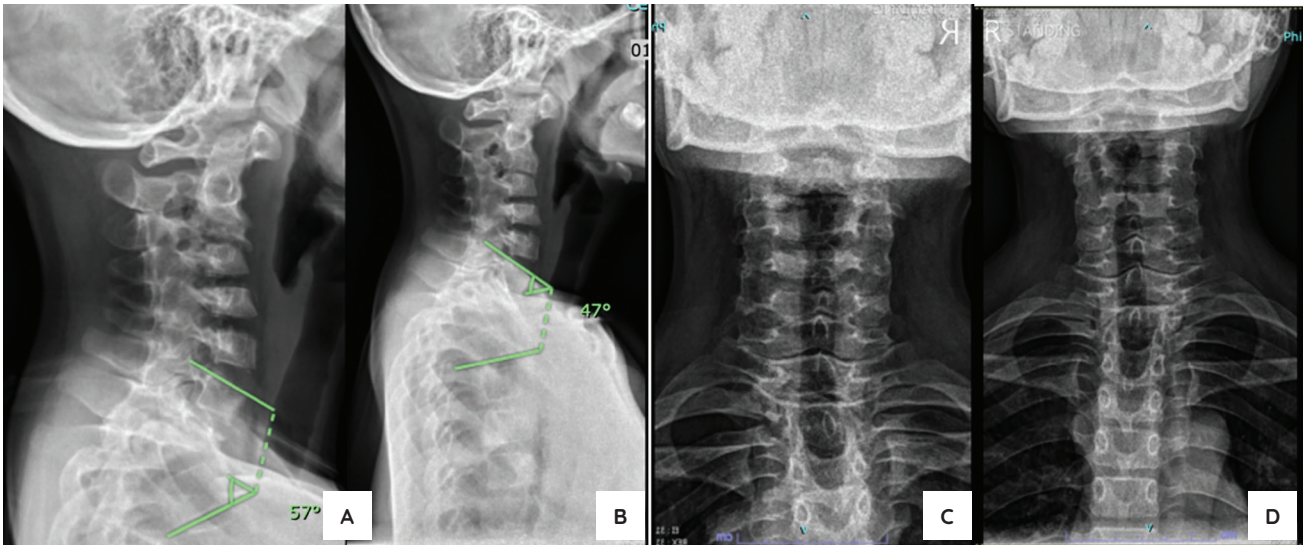

Figure 2. Patient # 2 Imaging studies. **(A and C)** Pre- treatment Cervical AP and Lateral radiographs. **(B and D)** Post- treatment (1 year): Cervical AP and Lateral radiographs.

the involvement of C2 indicated the long-term application of a halo vest.

Follow-up consultations at 5 months and 1 year post-treatment recorded complete recovery.

Patient #6

A 12-year-old female presented with a 3-month history of neck pain and paresthesias of both upper extremities. After 2 months, her pain worsened and she started having difficulty with ambulation and experiencing episodes of "clumsiness" when performing activities of daily living. Physical examination showed hyperreflexia of both upper and lower extremity deep tendon reflexes, positive clonus, and positive Hoffman signs. Imaging showed translation of C1 over C2 (Figure 7A and B).

Given the involvement of the atlantoaxial joint which was lysed on X-rays, she underwent a posterior occipitocervical fusion up to the C4 level. The final follow-up at one year showed no myelopathic signs and full neurologic recovery based on the Frankel grade (Figure 7C and D).

Patient #7

A 16-year-old male presented with a 4-month history of neck pain (NRS of 6/10) with no associated signs and symptoms. Two months later, the pain intensified (8/10) and the patient would have difficulty performing activities of daily living due to "clumsiness" and difficulty maintaining proper posture on the neck without any support. Physical examination showed hyperreflexia on both knees and Achilles deep tendon reflexes as well as inverted radial reflexes. Imaging showed desiccation of the C2 vertebral body and translation of C1 over C2 (Figure 8A). Like Patient #7, there is lysis of the C2 vertebral body extending to the atlantoaxial joint causing translation. There were no other adjacent joints involved.

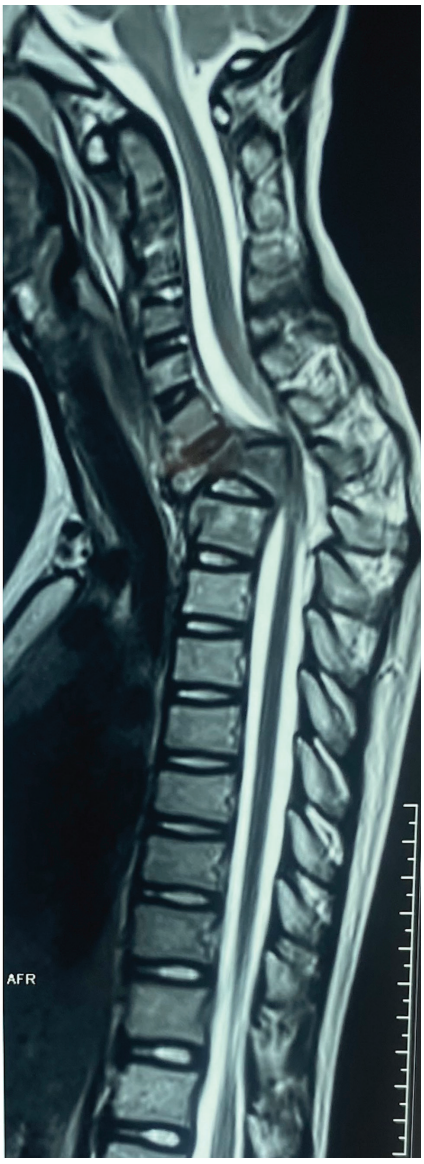

Figure 3. T2- weighted sagittal MRI Image of Patient 2.

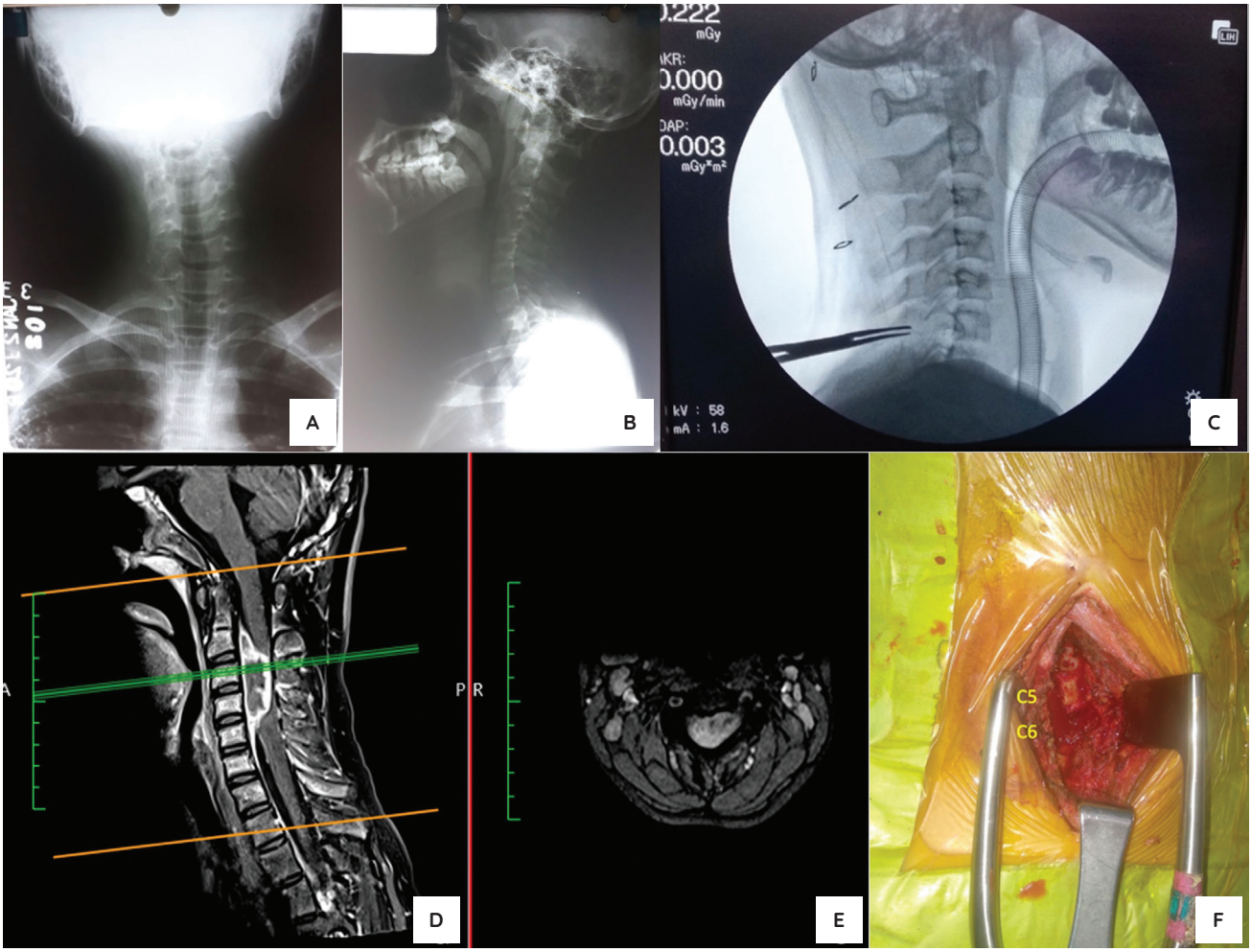

Figure 4. Patient 3 Pre-operative and Intra-operative images. **(A and B)** Pre-treatment AP and Lateral radiographs. **(C)** Intraoperative Lateral radiograph. **(D and E)** Pre-treatment T2 weighted MRI images. **(F)** Intraoperative clinical image of open drainage and biopsy.

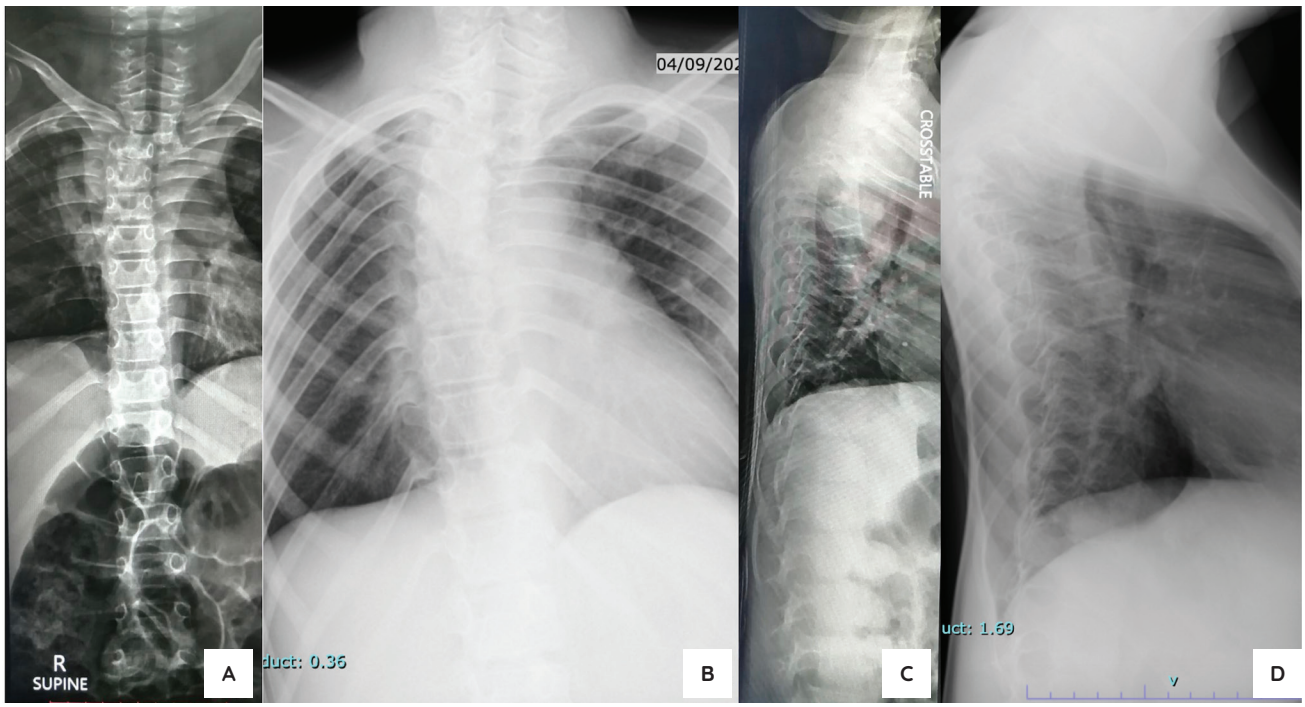

Figure 5. Patient 4 Radiographs 1 year apart. **(A and C)** AP and Lateral radiographs on initial consult. **(B and D)** AP and Lateral radiographs upon readmission for a medical problem. Patient initially refused surgery and was lost to follow-up.

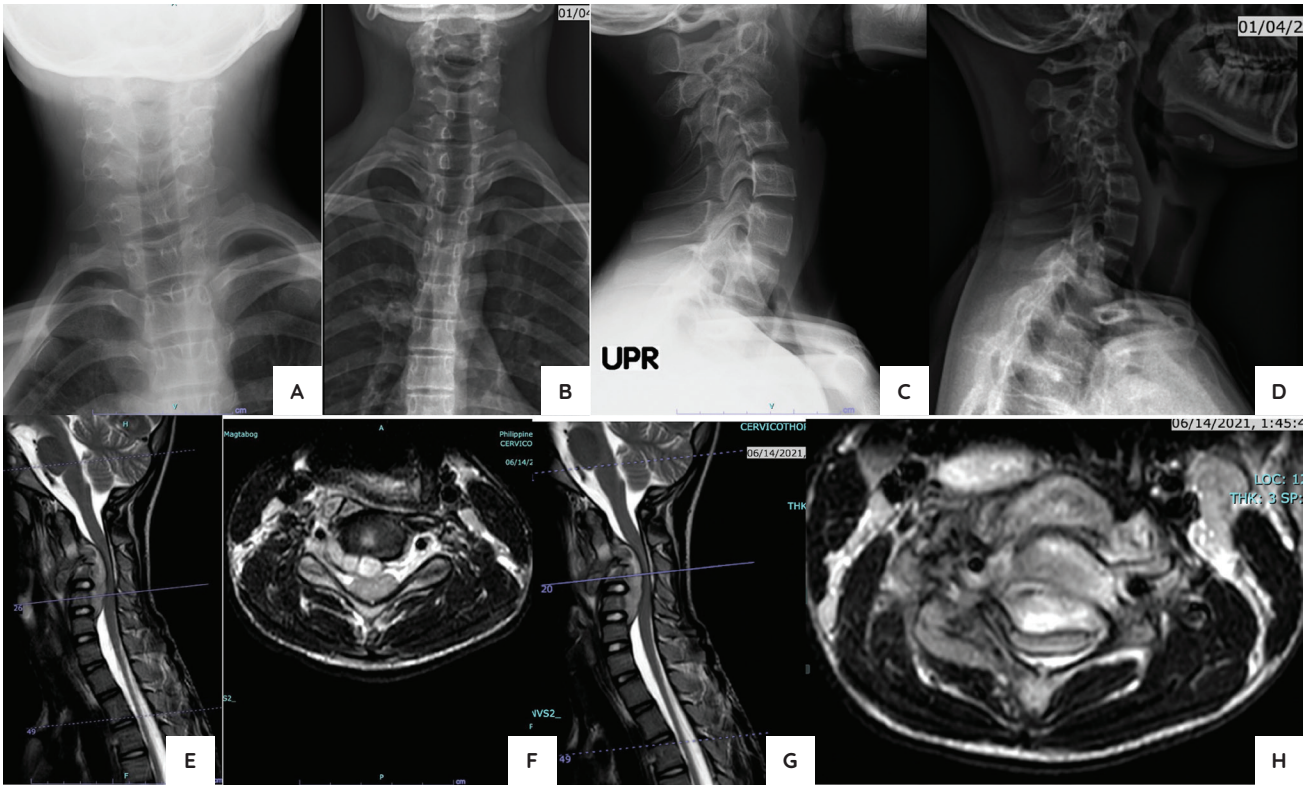

Figure 6. Patient 5 Radiographs (2 years apart) and T2- Weighted MRI. **(A and C)** AP and Lateral radiographs on initial consult. (**B and D)** AP and lateral radiographs on 2-year follow-up. **(E-H)** T2- weighted Sagittal and Axial representative images on the first consult.

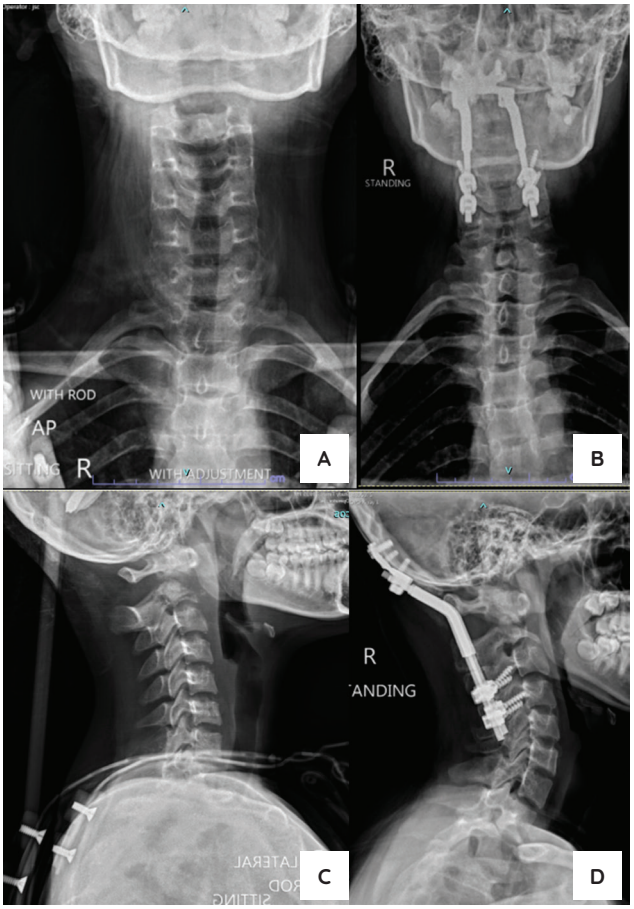

Figure 7. Patient 6 imaging studies. **(A and B)** AP and Lateral radiographs on initial consult. **(C and D)** AP and Lateral radiographs 1-year post-treatment.

This required occipito-cervical fusion. Follow-up consultations at 6 months and 1 year both showed no implant loosening and recovery of the cervical myelopathy (Figure 8B and C).

Patient #8

A 16-year-old female presented with a 5-month history of neck pain (NRS of 4/10) with limitation of movement and paresthesia on both upper extremities. Physical examination showed impaired sensation (LN C5). Imaging studies showed a 32-degree focal kyphosis on the affected level (Figure 9A and C). Given the limitation of movement, weakness, and one-column involvement, she was given a Xiangya Institute score of 6 (Grade II). The patient underwent Anterior Cervical Discectomy and Fusion. These resulted in improvement of kyphosis and functional recovery of Frankel grade at 5 months and 1 year post-operatively (Figure 9B and D).

Patient #9

A 3-year-old male presented with an 8-month history of neck pain and inability to perform range of motion of the neck and difficulty feeding. He then developed weakness in both hands and feet and was unable to ambulate independently. He also had a history of Tuberculous Arthritis on the left hip for which surgical debridement and arthrotomy were done in a previous tertiary hospital. ATT had already been initiated in the previous hospital.

The patient was in a hip spica cast upon examination. Both upper extremities and the right lower extremity did not show spontaneous movement and were hyporeflexive.

Imaging studies showed an abscess on the subaxial spine with spinal cord compression (Figure 10A-D). He was graded a Xiangya Institute score of 8 indicating surgical treatment with a posterior approach and possible anterior approach. The patient's family however preferred to return to their previous hospital and could not be followed up.

Patient #10

An 18-year-old female presented with a 6-month history of sudden-onset neck pain (NRS of 6/10), a 4-month history of increased intensity of pain (8/10) and difficulty ambulating, and a 1-month history of weakness of both upper and lower extremities. Upon examination, there were no noted motor and sensory deficits but all extremities were hyperreflexive and the patient had a wide-based gait.

Imaging showed abnormal kyphosis, sagittal-vertical angulation, a posterior abscess, and increased retropharyngeal spaces, (Figure 11A-F) all indicating spinal cord compression. The Xiangya Institute grade for this patient was 5 which

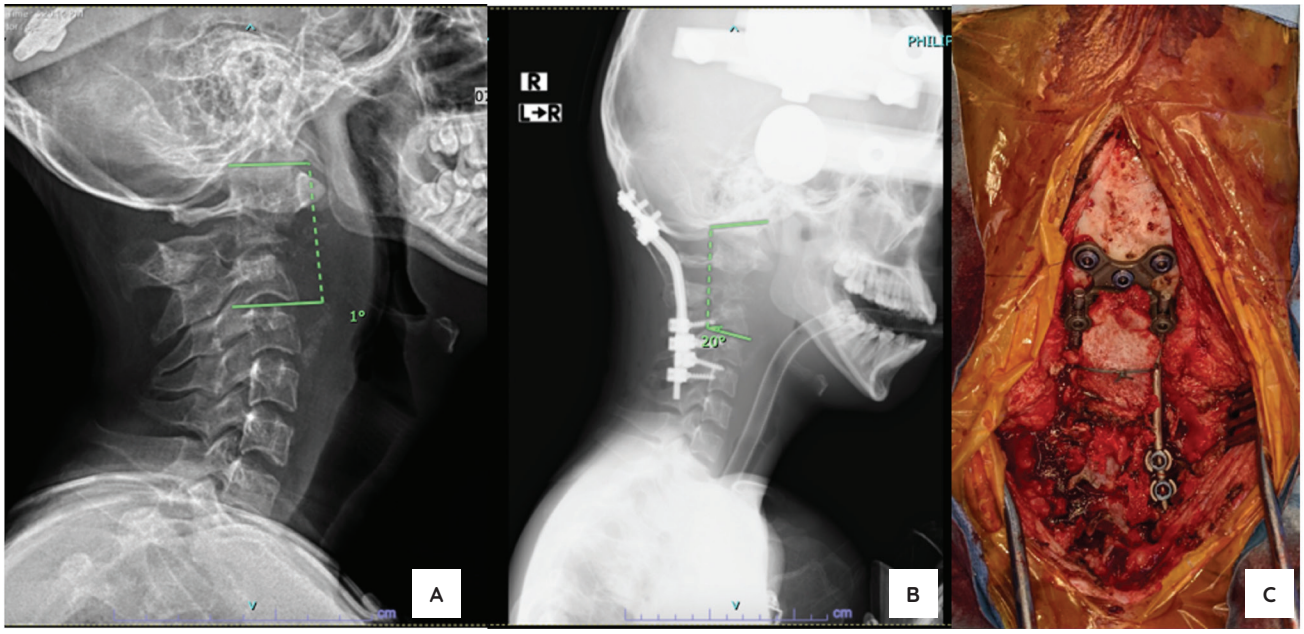

Figure 8. Patient 7 imaging and clinical pictures. **(A)** Pre-operative Lateral Radiograph. **(B)** Post-operative Lateral radiograph. **(C)** Intraoperative clinical picture.

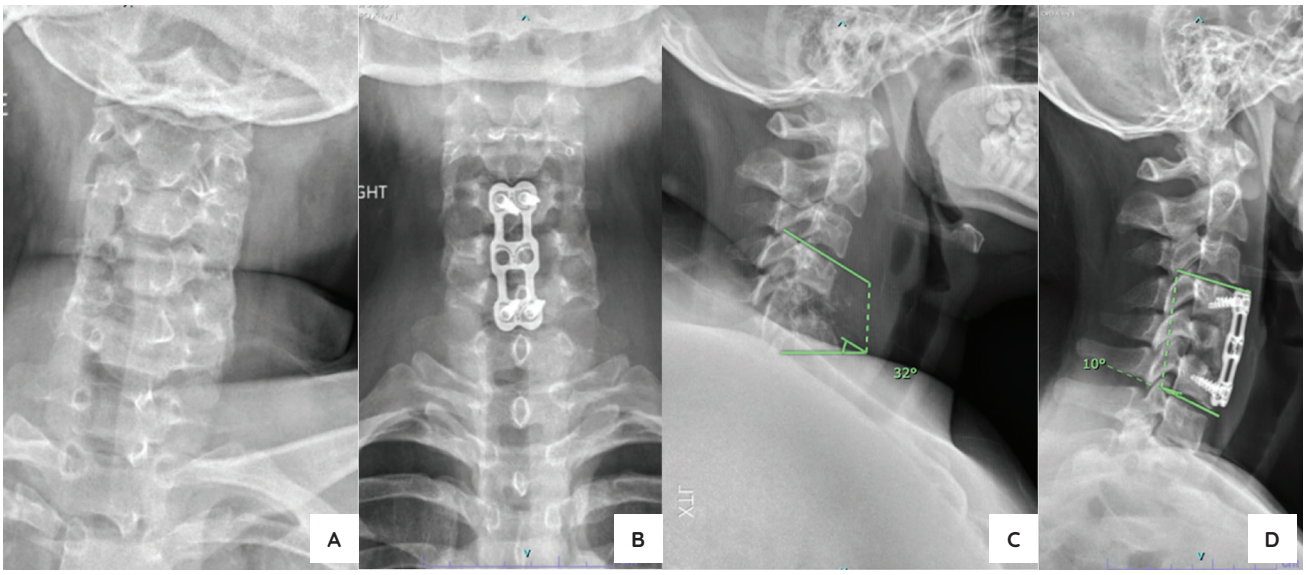

Figure 9. Patient 8 Radiographs 1 year apart. **(A and C)** AP and Lateral radiographs on initial consult. **(B and D)** AP and Lateral radiographs 1-year post-op/ initiation of ATT.

Figure 10. Patient 9 Images (Refused surgical management, continued ATT, opted transfer back to the hospital of origin). **(A and B)** AP and Lateral radiographs on initial consult. **(C and D)** T2- weighted MRI images Sagittal and Axial.

warranted an anterior surgical approach. Given the patient's complaint of dysphagia, the abscess was drained transorally. An orthosis was applied for immobilization. There were no remaining myelopathic signs at 3 months, 6 months, and 1 year follow-up.

Patient #11

A 9-year-old presented with a 1-month history of intermittent headaches and difficulty with ambulation. Examination showed a wide-based gait and no motor and sensory deficits. Imaging showed involvement of the tip and body of the C2 vertebra with decreased canal size and atlantoaxial joint lysis (AATB Grade 1) (Figure 12A-D). The patient started ATT and showed complete recovery on subsequent follow-up (6 months and 1 year).

DISCUSSION

Symptoms of cervical Pott's disease include pain, neurologic deficits, deformity, and constitutional symptoms (fever, weight loss, night sweats).[8] Pain is the most common symptom because cervical Pott's disease is a predominantly extradural pathology causing pain through dural irritation, free nerve ending irritation, endplate changes, and/or bony destruction.[15]

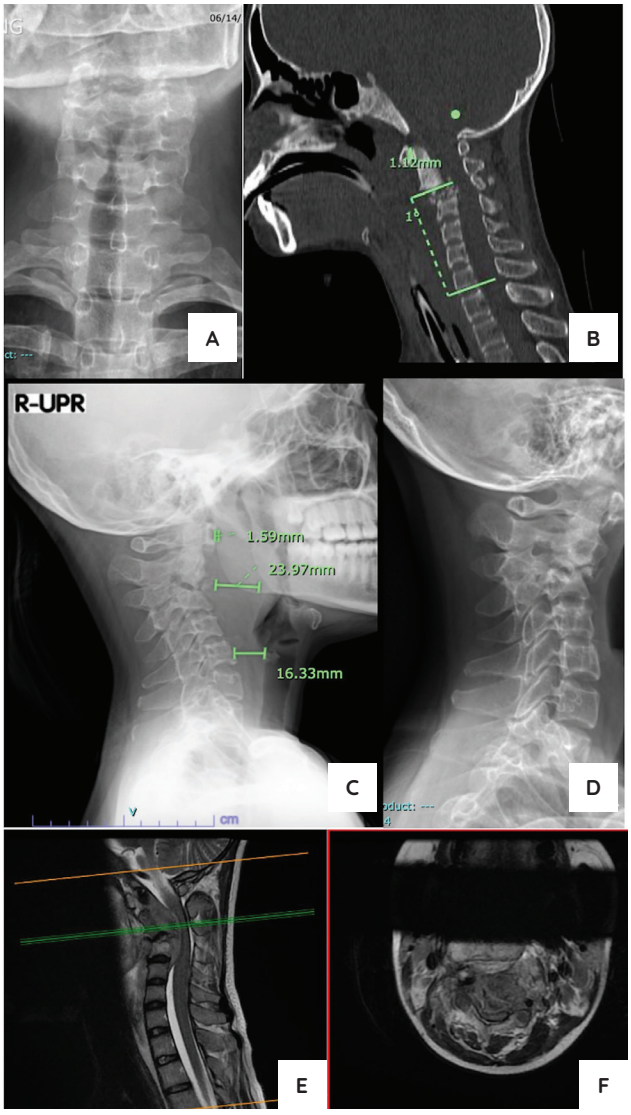

Figure 11. Patient 10. **(A-C, E-F)** Imaging studies on initial consult. **(D)** Lateral radiograph 1 year post-treatment.

Apart from pain, some patients presented with myelopathic signs graded using the mJOA score (Table 6). This is a revision of the previously published JOA score and is more applicable to cultures that do not use chopsticks regularly. The mJOA score assesses only motor dysfunction in the upper and lower extremities, sensory function in the upper extremities, and bladder function. Scores are mild if the mJOA score is 15 or larger, moderate if 12 to 14, or severe if less than 12.[16] Myelopathic signs in this study were present only in patients with AATB. These patients usually present with neck pain 50% of the time, neurologic deficits or numbness 70% of the time, and pyramidal signs 90% of the time. These include spasticity, weakness, slowing of rapid alternating movements, and hyperreflexia caused by corticospinal tract involvement.[15,17]

Clinically and radiologically, eight out of our eleven patients had a gibbus/kyphotic deformity. This is caused by the preferentially anterior osseous destruction.[18] This deformity, among other factors, caused the neurologic deficits.

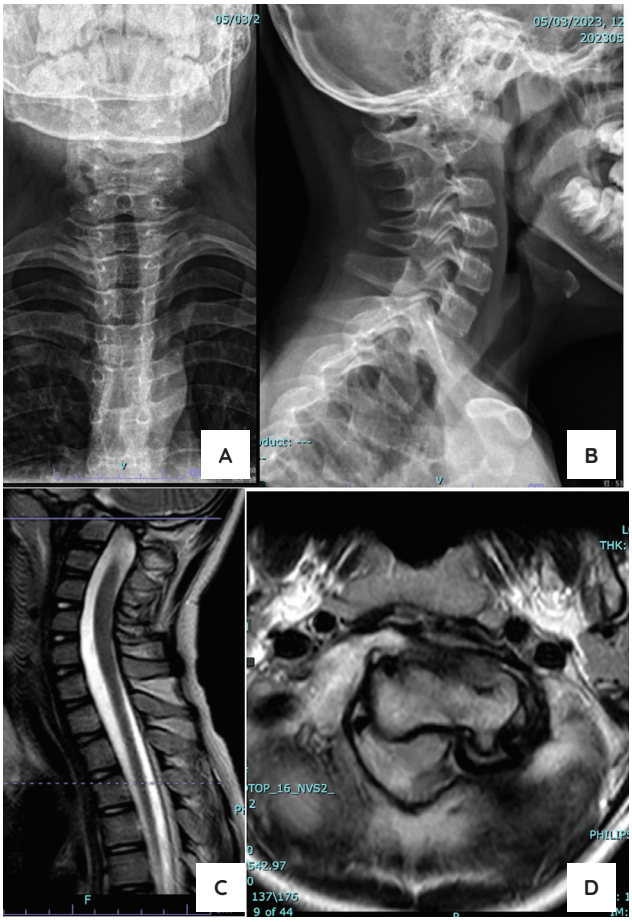

Figure 12. Patient 11 Imaging studies. **(A and B)** AP and Lateral radiographs on initial consult. **(C and D)** T2-weighted MRI images on initial consult.

With or without surgery, all patients showed at least one Frankel grade letter improvement (mean of 1.8). Myelopathic signs were also resolved post-treatment. Regardless of the type of cervical Pott's disease, surgical goals were the same: decompression for patients with progressive/severe neurologic deficits, stabilization, multilevel/pan-vertebral disease, open biopsy for patients with inadequate tissue samples or doubtful diagnosis, and debridement for patients with large/persistent abscesses.[18] The mainstay of treatment is still ATT.[19]

Although statistically not significant, younger patients presented with pathologies in the subaxial or cervicothoracic areas. All patients with SACTB were >10 years old and this is due to the vertical orientation of facet joints reducing upper cervical mobility and increasing subaxial cervical mobility.

Except for one patient who presented with myelopathic signs due to AATB (#11), all patients <10 years old presented with motor deficits resulting in worse Frankel grades because of the relatively poor muscle control, ligamentous laxity, and horizontal orientation of the facet joints causing increased mobility and compression.[20]

Patients with CTTB and SACTB presented with worse Frankel grades than patients with AATB. This is due to the relatively larger cross-sectional area of the atlantoaxial/upper cervical spinal canal.[17] For CTTB and SACTB, neurologic deficits are expected due to the mechanical effects of kyphosis, the small canal size, and the tenuous blood supply to the cord.[20]

CONCLUSION AND RECOMMENDATIONS

Cervical Pott's disease may still be seen in the pediatric population despite poor documentation. The mainstay of treatment is still anti-tubercular treatment (ATT), with surgery indicated for unstable cervical spines, depending on the location. After completing one year of treatment, an improvement of at least one letter Frankel grade is expected for patients.

ETHICAL CONSIDERATION

Patient consent forms were obtained before manuscript submission.

STATEMENT OF AUTHORSHIP

All authors certified fulfillment of ICMJE authorship criteria.

AUTHORS DISCLOSURE

The authors declared no conflict of interest.

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