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Original article

Clinical long-term consequences of thoraco-lumbar spine fracture and osteosynthesis

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Abstract:

Object: Although traumatic spine fractures can be treated by osteosynthesis, their long term clinical, social, and familial consequences are less known. The aim of this study was to assess these global consequences to a very long-term (at least more than 12 years after the fracture).

Methods: Two groups, one composed of 30 patients operated for a thoracolumbar fracture by posterior fixation and one with 30 controls (who never had a spinal fracture) matched for age, sex, job

and time of follow-up were studied. Patients and control subjects had to answer to 3 questionnaires: one about clinical, familial, and socio-professional changes, and 2 back pain (Dallas and Eifel) scales.

Results: The mean patient follow-up was 14,5 years (from 12 to 18 years, sd 2.3) - control subjects, 15 years. The majority (56%) of the fractures occurred at T12/L1 level. At last follow-up, the chronic low back pain concerned 20 (66,7%) patients versus 11 (36,7%) control subjects ($p = 0,03$); more patients (13 patients – 43,3%) consumed analgesics than control (5 persons – 16,6%) subjects ($p = 0,04$). A large majority (13 patients, 57%) had sick leaves that exceeded 6 months. The loss of wage due to traumatism or chronic low back pain was also significant ($p = 0,002$) between patients and matched controls over the period. At follow-up, the mean Eifel score for the whole patients' cohort was significantly superior compared to control group (4,7 (sd 3,75) VS 2,6 (sd 4,2), $p = 0,008$). Dallas score was superior in the patient's group for the daily, work-leisure activities and sociability aspect ($p < 0,05$).

Conclusion: Chronic back pain, long sick leaves, changes in professional and familial life, the very long-term postoperative outcome of patients could be more difficult than expected in a majority of patients operated for thoracolumbar fracture. In order to facilitate the back to work and reduce these long-term consequences, we propose that guidelines about job resume in traumatic spinal fractures should be established along with early occupational medicine consultations.

Level of evidence: IV, grade C ; retrospective study

Key words: spinal osteosynthesis, chronic low back pain, sick leave, social rehabilitation, occupational medicine

Introduction

Spinal fractures ranked only at the 21st rank among all adult fractures[1] (with an incidence around 79 000 each year in the USA[2]) but their severity and consequences can be devastating. Falls (39%) and traffic collisions (26 %) are the two most common causes of spinal fractures[3], the thoracic and lumbar spines being the most affected[3]. The ability to return to previous activities or “normal” life is

related, among other factors, to the initial severity of the traumatism. Their treatment can be conservative or surgical by stabilizing the fracture[4] and if needed, to release spinal cord and nerves injuries[5]. Although the indications and the technique are in constant development⁵, osteosynthesis of the damaged spine by screws and rods through an open posterior approach is still the most commonly used technique.[6,7] Spine osteosynthesis is routinely used in many countries to improve patient recovery with reputed good immediate results.[8]

However, the possible long term consequences of spine fractures treated by osteosynthesis (such as pain, disability, extended sick leaves, and sometimes inability to return to previous work) are less known.[9][10] The literature provides little or conflicting data about the socio-economic impact following thoracolumbar osteosynthesis surgery. For instance, in the Reinhold et al. series, [11] the average sick leave of patients who had spine surgery because of a thoracolumbar fracture was 4 months long. But, in Tasdemiroglu et al.[12] series, only 26 % of patients were able to work after 66 months of follow-up, osteosynthesis of the spine providing chronic low back pain and having a negative impact on the patient's daily life. In McLain et al.[13] series, 70% of patients with a thoracolumbar fracture and osteosynthesis were able to return to work but only within two years.

In this original retrospective study, we evaluated the long-term outcomes of patients with thoracic and lumbar spine fractures treated by osteosynthesis, considering that the long-term consequences of these fracture could be underestimated. We deliberately chose to consider a very long-term follow up (at least more than 12 years after their traumatism) to evaluate the outcome, focusing on the socio-economical outcomes and chronic low back pain. The aim of this study was to assess these global consequences to a very long-term (at least more than 12 years after the fracture).

Material and methods

Patients

The criteria of inclusion were patients older than 18 years of age treated for a thoracic, thoracolumbar or lumbar osteosynthesis without neurological deficit, at least 10 years before the beginning of the study. All patients had been operated by an open posterior approach, using pedicle screws or hooks

and rods (Xia by Stryker). Depending on the severity of the fracture, the surgeon chose to perform a short (<3 levels) or long (>3 levels) fixations. Patients operated with laminectomy was excluded.

The medical files of 137 patients who had a thoracic or lumbar fracture surgery between 2000 and 2006 in the neurosurgical department of University Hospital of Toulouse (France) were retrospectively reviewed. Their postal and email addresses were registered in order to send to all of them questionnaires that they returned by mail. Patients were also contacted by phone call to answer questions about the post-surgery long term effects. Overall, 107 patients were excluded from our database. Because their charts were not fully complete for the strict requirements of this study (68 patients) or because patients could not be reached because their contact details changed (37 patients). Two more patients died in the follow up interval. Overall, 30 patients had fully answered questionnaire and chronic low back pain evaluation scales and were included in this study. The demographics and clinical data - age, gender, short (≤ 3 levels) or long (>3 levels) fixation construct – were classified and reviewed.

Questionnaires

Three questionnaires were used. First, one questionnaire with 20 close-ended questions related to various post-op items: duration of sick leaves, need to adapt the workplace or working hours, professional change or reassessment, wage loss, time spent for leisure-activities, negative outcomes on the family life, modifications of the residence, chronic low back pain and analgesic consumption, discomfort caused by the material (**Annex 1**).

Furthermore, 2 evaluation scales of the chronic low back pain have been sent to the patients: The Dallas pain questionnaire (**Annex 2**), a group specialized with spinal traumatism within the French Society of Rheumatology[14]. This questionnaire includes a total of 16 questions, using an analogue visual scale for each question, to measure the influence of chronic low back pain that affect four aspects of the patients' lives: daily and work-leisure activities, anxiety-depression, and social interest.

The answers are expressed as a percentage of severity for each of these different aspects. The third questionnaire was the “Roland Morris Low Back Pain Questionnaire, a well-renowned within Anglo-Saxon literature as a tool to measure chronic low back pain and the quality of life. [15] It was translated in French (“EIFEL” scale), as the ”*Echelle d’Incapacité Fonctionnelle pour l’Evaluation des Lombalgies*” (**Annex 3**) – The functional incapacity scale on the evaluation of chronic low back pain. The results are on the scale of 0-24. The higher the score, the more the chronic low back pain is incapacitating.

Control Group

The control group, made up of 30 adult volunteers recruited from the general population, was matched with the study group for 4 criteria, *sex, age, job, and time of follow-up*. Difference between patient and control groups were not significant in terms of age, sexe and time of follow-up ($p>0.05$). Groups were similar in terms of jobs (**Table 1**). Only people who never had spine surgery were included in the control group. Controls responded to the same questionnaire that the patient group lending over a period between 2004 to 2016 (**Annex 4**) and to the 2 evaluation scales, the Dallas pain questionnaire and the “EIFEL”.

Statistical analysis

All tests were performed by our statistician using R® for 3.2.4 GUI 1.67 Mavericks build (7152). We used a Chi-squared test to compared the time devoted to sports or leisure activities between patients and controls before the surgical management et then after the surgical management.

To compare the others categorical variables (patients and controls categorical characteristics; lombalgic issues, family life, professional outcomes, and analgesics consumption between patients and controls) we performed Fisher’s exact test. To compare quantitative variables (Dallas and EIFEL ladders scores between patients and controls; between patients with sick leave exceeding 6 months and those with sick leave that lasted less than 6 months; between controls and Frankel E and Frankel A

patients), we performed Mann-Whitney U test. There was no significant differences in time devoted to sports or leisure activities between patients and controls before the surgical management and then after the surgical management ($p= 0.7086$, $p= 0.7773$ respectively).

Results

Patients

The mean length of the follow-up was almost 14.5 years (from 12 to 18 years, sd 2.3). The mean age of the 30 patients of this series was 40.4-year-old (from 18 to 73-year-old, sd: 16.6) at the time of the trauma and 55.5-year-old (from 30 to 88-year-old, sd: 16.7) at their last follow up. The man/woman ratio was 3:1. The majority of the fractures occurred at T12/L1 level (43 % of fractures occur at L1, 10% at T12). Traffic accident were responsible for 53,3 % of traumatisms (16 patients). Thirteen patients were treated after fall and one patient after an accident with a farming machine at the workplace. These data are illustrated in **Table 2**.

The initial average length of hospitalization was 12.3 days (from 3 to 48 days, sd 7.3). Four patients have been re-operated on, in order to remove the material (3 due to uncomfortable material, 1 because of infection), at an average of 17.8 months (from 3 to 46 months, sd 16.7).

Long term outcomes

Pains and analgesics

At the last follow up, the chronic low back pain concerned 20 patients (66,7%) versus 11 persons of the control group (36,7%). This difference was significant ($p = 0,03$). Furthermore, more operated patients (13 patients – 43,3%) consumed analgesics than controls (5 persons – 16,7%); again this difference was significant ($p = 0.004$).

Finally, in the patient group, we compared the 9 patients suffering with long fixation constructs from chronic lumbar pain (90% of them) with the 21 patients with short fixation constructs and chronic lumbar pain (67%). This difference was not statistically significant ($p=0,1$).

Leisure-activities

Before the accident, the time devoted to sports or leisure activities was more than 3 hours for 20 patients (66,6%) and less of 3 hours a week for 10 patients (33,4%) of this cohort. At follow-up, only 12 patients still practiced more of 3 hours of sport or leisure activities a week (40%) and 19 patients (60%) estimated their leisure time <3h since the accident. The comparison between pre-operative and follow-up leisure activities was not significant ($p= 0.7086$). However, at follow-up 6 patients of the study (20%) had to stop their favorite leisure activity after surgery while 10 controls (33,3%) reported having stopped their favorite activity during the last 12 years. No difference was found between the 2 groups ($p=0,15$).

Family life

Two (6,7%) patients estimated that their trauma had a negative impact (conflict or divorces) on their family life. Compared to matched controls (only 3 controls- 6,6%- suffered from the same family life issues in the period of 12 years), the difference was no significant ($p > 1$).

Professional outcomes

Over the 30 patients, 2 patients (4%) were students and 5 were retired (16,7%) when the spinal fracture occurred. Twenty-three had a job at the time of the accident. Among them, a majority (13 patients – 57%) had a sick leave that exceeded 6 months; 7 patients (30%) between 3 and 6 months and only 3 patients (13%) had a sick leave shorter than 3 months.

Among the 23 patients who worked previous the accident, 14 patients (60%) could return to their previous work without professional changes. Four patients of the cohort (17%) adapted their workplace after the post-traumatic thoracolumbar osteosynthesis surgery of the spine. Changes in the working hours occurred for 8,6% of patients when they returned to active life. Two patients were professionally reassigned in their firm due to physical incapacity (8,6%) and 3 had to change jobs (13%). Overall, 8 (27% of these 23 previously working patients) estimated they lost money because of the professional outcomes due to the trauma. Compared to matched 1 (3,3%) control subjects who declared a loss of wage since 12 years, the difference was significant ($p = 0,025$)

Outcome of chronic low back pain on the daily activity (Eifel and Dallas scores)

Spinal fractures treated by osteosynthesis affected significantly long-term outcomes in term of chronic chronic low back pain. At follow-up, the mean Eifel score for the whole patients' cohort was 4,7 (sd 3,75) and 2,6 (sd 4,2) for the control group ($p = 0,008$). **Table 3** summarizes the results of the two chronic low back pain evaluation scales. Compared to control group, Dallas score was superior in the patient's group for the daily and work-leisure activities ($p < 0,001$) and for the sociability aspect of patient life ($p = 0,005$)

Discussion

In this study on traumatic spinal fractures without initial neurologic deficit and treated by osteosynthesis, the personal, professional, and familial outcomes were worse than suspected considering that the very long-term follow up (12 years) should have promoted a certain return to baseline in patients. First, compared to control population, persistent lumbar or back pain was present in a majority of these patients with severe repercussion on some aspect of the patient' life. Long term analgesics consumption for pain was also significant. The scores of the Dallas questionnaire were higher in the aspects "daily activities", "professional and leisure activities" and "sociability aspect of life". This can be interpreted as an organic result due to the chronic low back pain and not as a

psychological result, as the “anxiety” aspect was less affected by the chronic low back pain. Secondly, our data shows that the professional outcomes can be rather difficult for a majority of these patients. Among the most striking result, a majority of the patients with no initial neurological troubles had sick leaves that spent more than 6 months. As global consequence, although 60% of the patients could return to their previous work. However, long-term changes in leisure or sport activities were not significant in these patients compared to matched controls. In summary, chronic back pain, long sick leaves or significant changes in social and familial life, the very long-term postoperative outcome of patients with spinal fractures was difficult in a majority of patients.

This study has some limits. The number of patients lost was important and probably conceptual with long-term studies: sometimes charts were not correctly filled in emergency (or not filled as required for our study), or X-Rays performed outside our institution were lost or unavailable. Patients also moved or change their phone number and could not be included in this study. Another potential limit is that over 15 years, our knowledge on sagittal balance and the techniques of osteosynthesis could have improve and we evaluated the outcome on rather old osteosynthesis practices. All the patients from these series have been operated through a posterior open approach, however many centers developed through years less invasive techniques, like percutaneous osteosynthesis[16][17] or vertebroplasty surgeries[18]. Those two techniques showed an improvement on the immediate post-op pains[19][20] but we found few studies which estimate the long term outcome as sick leave or chronic chronic low back pain with these more recent techniques. According to Cimatti et al.[21], 75 % of the patients from their series could return to work 4 weeks after the operation through a percutaneous osteosynthesis. The development of these percutaneous techniques may decrease the socio-professional consequences of patients treated for thoraco-lumbar spine fracture. Nevertheless, long term evaluation is needed before concluding to the advantage of this percutaneous techniques over *long term clinical and social issues*. Recently, the integration of essential notions of sagittal balance in spinal surgery has improved the clinical results of operated patient. Restoring a physiological lordosis after kyphotic deformation is essential to reduce the risk of long-term rachialgia.

Lombalgic issues

Two-thirds of the patients of this series had a chronic low back pain at their last follow-up, i.e. 66% of our patients had daily back pain in a mean of 12 years after their traumatism. Chronic low back pain is frequent complication after lumbar spine surgery[13]. According to Loisel and al.[22] who developed and tested a model of management of subacute back pain to prevent prolonged disability, an early return to work is part of the treatment against chronic low back pain. For the patient that suffers from chronic low back pain, the return to work is actually a therapeutic act and not a goal as such.[22][23] Furthermore, Loisel et al. found that patients treated with overall care (clinical and occupational) returned to regular work 2.41 times faster than the patients treated with usual care intervention.[22] As the return to work is considered a therapeutic act, the orthopaedic surgeons, neurosurgeons, occupational doctors, and general practitioners have to take part in the process of returning to work[24].

Sick leave issues

In this study, operated spinal fractures usually caused sick leaves lasting more than 6 months, which had a negative impact on the return to professional activity. The first finding is that spine surgeons may underestimate the real impact of spinal fractures, considering that once operated, patients should be able to soon return to a “normal” life. This was not the case in many patients. Patients sometimes consider that the traumatic spinal fracture is a serious event, probably in their eyes more serious than estimated by medical staff taking care of them. Beyond this finding and except for the patients with neurological lesions, the causes of such a long sick leaves in patients with no sign of neurological damage are hypothetic. Our goal is to understand these patients and the negative impact of spinal fractures. In France, as in many countries, the decision to return to work is rather complex but the advices of the surgeon or of the general practitioner are important. However, there is until now in France no recommendation regarding the necessary time of sick leave after an operated thoracolumbar spine fracture (as moreover in many countries). This time has to be adapted to the gravity of the fracture, to the neurological damages it caused, to the trauma but also to the patient’s profession. It has

been shown that a sick leave exceeding 6 months represents a loss of opportunity by 50 % to return to active life and by 80% to have a sick leave lasting more than a year[25]. The lack of anticipation to the return to work can generate longer sick leaves and can lead to a definitive exclusion of professional activity.

Our results with a majority of long sickleave could suggest that the intervention of the occupational physicians in the return to active life came usually too late in the after-care. As in many other countries, France provides an organized occupational medicine, which role is to facilitate that return to work[26]. The occupational physician is the only one who knows the work environment of the patient and the firm policy concerning that matter. In theory, the occupational physician coordinates a pluridisciplinary team, whose main purpose is to maintain the worker in his job. Unfortunately, general practitioners, specialists or patients were late to ask for a consultation previous to the return to work. In general, the lack of coherence of the medical staff about the adapted back to work put the patients in wait-and-see condition and can create some anxiety about the work resumption. It could be essential to harmonize our knowledge and optimize the job resume very early, including spine surgeons, general practitioners and occupational physicians.

Some clinical studies[27][28][29] demonstrated the beneficial impact of the early job resumption, with the goal to preserve patients' employment and more widely their further quality of life. This is a general issue in Europe where this early patient care by occupational medicine is not the rule[30]. But, some countries tried recently to early anticipate the work reintegration. For instance, in the Netherlands, the Social Security overrees the measures of rehabilitation from the thirteenth week. In Denmark, the potentialities of rehabilitation are estimated, planned and financed by the Social Security only 3 months after the beginning of the sick leave. In France, the specificity of the occupational healthcare is still too much underestimated by the physicians and could be one of the factor of these long term patients' difficulties.

This study has certain limitations, notably in the inclusion of all adult patients, young or old. Comorbidities, age and degenerative changes in the lumbar spine, muscle atrophy might influence

clinical outcome measures. Radiologic reduction, fusion or degenerative change were not included in this study because of the lack of radiological data.

Conclusion:

Our results showed that spinal thoracolumbar fractures, treated by osteosynthesis through a posterior open approach, have long-term adverse outcomes on the professional, familial and social life of patients. We suggest that an early consultation with occupational medicine on the recommendation of the surgeon could be essential to all the employees in order to best prepare their return to active life and to shorten the time of inactivity. Less invasive techniques of osteosynthesis could also improve global prognosis of these spinal fractures. The establishment of “good policy” procedures for return to work at the level of public health should guide all the practitioners, including neurosurgeons, in the post-operative period of these patients.

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Author contribution: Pierre Brandicourt and Luby Nicolas: writing study

Imene Djidjeli, Amaury De Barros and Ing Cheng: data collection and statistical analysis

David Brauge and Franck Emmanuel Roux: study design

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Table 1: Main characteristics of patient groups and control groups

| | Patient (%) | Control (%) |
|---|-------------|-------------|
| Age (mean, yrs) | 55,1 | 57,2 |
| Male | 19 (63) | 19 (63) |
| Female | 11 (37) | 11 (37) |
| Total | 30 | 30 |
| Follow Up (mean, yrs) | 14,5 | 12 |
| Professional group* | | |
| 1. Farmers | 1 (3,3) | 1 (3,3) |
| 2. Artisans, merchants | 3 (10) | 2 (6,6) |
| 3. Managers and higher intellectual professions | 3 (10) | 5 (16,7) |
| 4. Intermediate Occupations | 3 (10) | 4 (13,3) |
| 5. Employees | 16 (53) | 12 (40) |
| 6. Manual workers | 1 (3,3) | 2 (6,6%) |
| 7. Unemployed | 3 (10) | 4 (13,3) |

*Type of profession according to the Insee Classification of Occupations (Insee : *Institut national de la statistique et des études économiques*)

Table 2: Patient characteristics

| Level of fracture | Nombre (% of patients) |
|---|-------------------------------|
| T7 | 2 (6,6) |
| T12 | 5 (16,6) |
| L1 | 13 (43,3) |
| L2 | 8 (26,6) |
| L3 | 1 (3,3) |
| L4 | 1 (3,3) |
| Classification of fracture (AOSPINE) | |
| A | 7 (23%) |
| B | 20 (67%) |
| C | 3 (10%) |
| Type of accident | |
| Fall | 13 (43,3) |
| Traffic collision | 16 (53,3) |
| Work accident | 1 (3,3) |
| Type of osteosynthesis | |
| Long | 9 (30) |
| Short | 21 (70) |

Table 3: Results for 50 patients and 50 controls

The middle columns show the number of patients or control subjects for each item. The right-hand column shows the statistical analysis and the statistical significance.

| Characteristic | 30 Patients | 30 Controls | p value |
|--------------------------------|-------------|-------------|---------------------|
| Job adaptation | 4 | 2 | p = 0,25 |
| Work timetable adaptation | 2 | 3 | p = 1 |
| Professional reclassification | 2 | 3 | p = 1 |
| Change of profession | 3 | 8 | p = 0,18 |
| Loss of wages | 8 | 1 | p = 0,025 |
| Favorite leisure/sport stopped | 6 | 12 | p = 0.15 |
| Divorce or conflict | 3 | 2 | p = 1 |
| Move out of home | 3 | 14 | p = 0,03 |
| Lumbar pain | 20 | 11 | p = 0,03 |
| Analgesic consumption | 13 | 5 | p = 0,04 |
| EIFEL score | 4,7 | 2.6 | p = 0,008 |
| DALLAS score: | | | |
| -Daily activities | 36,1 | 14,7 | p < 0.001 |
| -Prof. and leisure activities | 21,7 | 6,7 | p < 0.001 |
| -Anxiety | 17,3 | 12,7 | p = 0.10 |
| -Sociability | 13,3 | 4.3 | p = 0,005 |