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Reconstruction versus no reconstruction of iliac crest defects following harvest for spinal fusion: a systematic review

A review

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Object. Autologous bone from the iliac crest is commonly used for spinal fusion. However, its use is associated with significant donor site morbidity, especially pain. Reconstructive procedures of the iatrogenic defect have been investigated as a technique to alleviate these symptoms. The goal of this study was to assess the effects of reconstruction versus no reconstruction following iliac crest harvest in adults undergoing spine surgery.

Methods. The authors searched the Cochrane Central Register of Controlled Trials (The Cochrane Library 2011, Issue 4); MEDLINE (1948–Oct 2011); EMBASE (1947–Oct 2011); and the reference lists of articles. Randomized controlled trials (RCTs) or nonrandomized controlled trials (NRCTs) were included in the study. Two independent reviewers selected the studies, extracted data using a standardized collection form, and assessed for risk of bias.

Results. Three RCTs (96 patients) and 2 NRCTs (82 patients) were included. These had a moderate to high risk of bias. The results suggest that iliac crest reconstruction may be useful in reducing postoperative pain, minimizing functional disability, and improving cosmesis. No pattern of other clinical, radiological, or resource outcomes was identified.

Conclusions. Although the available evidence is suboptimal, this systematic review supports the notion that iliac crest reconstruction following harvest for spinal fusion may reduce postoperative pain, minimize functional disability, and improve cosmesis.

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Key Words • **systematic review** • **reconstructive surgery** • **bone substitute** • **bone transplantation** • **ilium** • **postoperative complication** • **spinal fusion**

Autologous bone from the iliac crest has for decades been harvested as a substrate for spinal arthrodesis. Unfortunately, donor site morbidity and the requirement for a second surgical site have been major detriments for its unhindered use.[6] Whereas most donor site complaints usually resolve with time, a number of patients unfortunately experience persisting symptoms that become a significant source of postoperative morbidity. Chronic pain at the iliac crest is arguably the most significant complication, occurring in approximately 20% of patients.[20,26,28] The mechanism of the pain is unclear, but has been speculated to be due to trauma to the periosteum or muscle or to neuroma formation.[32] Additionally, others have suggested that patients undergoing lumbar surgery may have confusing, referred pain.[9,18] A wide range of other complaints, including quality of life and cosmetic issues, have also been documented.[20,26,28]

Despite this, autograft from the iliac crest remains the gold standard substrate because currently no substitute supersedes its combined osteogenic, osteoinductive, and osteoconductive potential in promoting bony fusion.[6] For many surgeons, especially those in countries where cost is an additional significant constraint, autograft remains a reliable, attractive, and easily accessible option, and so its utility remains widespread.[4] Autograft from other sites, notably local decompressed bone, has also become widely used. In certain procedures, such as single-level posterolateral lumbar fusion, local bone has been shown to be equivalent to iliac crest harvest, although its success decreases with increasing levels.[27]

While research into bone graft substitutes such as

Abbreviations used in this paper: CHA = coralline hydroxyapatite; ICM = inductive conductive matrix; NRCT = nonrandomized controlled trial; RCT = randomized controlled trial; SF-36 = 36-Item Short Form Health Survey; VAS = visual analog scale.

ceramics and bone morphogenetic protein continues,[6] efforts have concurrently been made to support iliac crest autograft procedures by developing methods to alleviate donor site morbidity. Medical therapies that have been investigated include intraoperative[31] and continuous postoperative anesthetic administration,[22,29] which have achieved mixed results.

Surgically, many techniques such as rounding of bony edges,[30] harvesting from the posterior instead of the anterior iliac crest,[2] and minimally invasive procedures, among others, have been suggested.[24] Finally, reconstruction of the iatrogenic defect, first proposed by Hardy in 1977,[14] has been investigated. Similar to the unknown mechanism of donor site pain, the way in which reconstruction may alleviate morbidity is also unclear.[32]

Currently, no systematic synthesis of the efficacy of this "backfill" procedure exists in the literature. Hence, the aim of this review is to assess the effects of reconstruction versus no reconstruction of iliac crest harvest defects in adult humans undergoing spine surgery.

Methods

Types of Studies

All prospective controlled human clinical studies (level III-2 evidence or higher) were considered (see Table 1 for hierarchy of evidence). This included a search for NRCTs as well as RCTs, in anticipation of a low number of the latter.

Types of Participants

We considered male and female adult patients who underwent iliac crest harvest as a donor site for spinal surgery.

Types of Interventions

We compared the intervention of iliac crest reconstruction versus no reconstructive procedure following iliac crest harvesting. We considered all types of reconstructive material, including autologous, allogeneic, and synthetic materials.

Outcomes Assessed

The primary outcome assessed was the effect on donor site pain. Secondary outcomes included quality of life/functional disability, cosmetic appearance, radiological analysis, resource use (such as hospital stay), and any notable complications (such as skin necrosis, bursitis, meralgia paresthetica, herniation, and gait disturbance).

Search Strategy

A literature search of the Cochrane Central Register of Controlled Trials (The Cochrane Library 2011, Issue 4); MEDLINE (via Ovid) (1948–Oct 2011); and EMBASE (Ovid) (1947–Oct 2011) was performed in Week 3, October 2011. The specific prospective search protocol for each database is outlined in Table 2. No language restrictions were used. In addition, the reference lists and citation history of all full-text articles retrieved were checked using Scopus. A search for ongoing or recently completed trials was performed in Week 1, November 2011 in the US Clinical Trials (www.clinicaltrials.gov), UK Current Controlled Trials (www.controlled-trials.com), and Australian New Zealand Clinical Trials (www.anzctr.org.au) registries by using similar keywords.

All titles were assessed, and where the abstract suggested a potentially eligible study, the full text was retrieved. Studies were critically evaluated for design and risk of bias, and were classified according to level of evidence (Table 1).[23] Data were extracted onto a standardized collection form by 2 independently working authors (A.C. and L.X.) and entered into RevMan version 5.1.4.

TABLE 1: National Health and Medical Research Council hierarchy of evidence

Level	Study Design
I	systematic review of level II studies
II	RCT
III-1	pseudo-RCT
III-2	comparative study w/ concurrent controls
III-3	comparative study w/o concurrent controls
IV	case series

Results

Evidence Base

Included Studies. The literature search returned the following number of articles: CENTRAL (87), MEDLINE (512), and EMBASE (494) (Fig. 1). From these, 5 articles were found to be appropriate for the clinical question, of which 3 were RCTs[5,25,33] and 2 were NRCTs (Table 3).[4,12] The indications for iliac crest harvesting in these studies were all related to spinal fusion. No studies from other disciplines such as oral maxillofacial surgery were located. The study by Yang et al.[33] was translated into English and evaluated.

Excluded Studies. The search strategy yielded 1 controlled study, which was excluded because it was retrospective.[32] A number of other studies were excluded due to their retrospective nature and/or lack of controls.[1,3,7,8,11,13–15,17,19,21] At the time of this writing, 1 prospective NRCT had recently completed recruitment and was not yet available for analysis (see http://clinicaltrials.gov/ct2/show/NCT00837473).

Critical Appraisal of Included RCTs. Descriptions of each included RCT are provided in Tables 4–6. The risk of bias was assessed according to the guidelines set out in the Cochrane Handbook (Table 7).[16]

Critical Appraisal of Included NRCTs. Descriptions of the NRCTs are provided in Tables 8 and 9. The risk of bias was assessed according to the validated checklist developed by Downs and Black (Table 10).[10]

Statistical Analysis

Given the small number of patients from RCTs and the heterogeneous interventions, a meta-analysis of data was not performed.

TABLE 2: Literature search strategy, using MeSH (CENTRAL, MEDLINE) and Emtree (EMBASE) terms*

No.	CENTRAL	MEDLINE	EMBASE
1	MeSH descriptor reconstructive surgical procedures explode	exp reconstructive surgical procedures	exp plastic surgery
2	MeSH descriptor bone transplantation explode all trees	exp bone transplantation	exp bone transplantation
3	MeSH descriptor bone substitutes explode all trees	exp bone substitutes	exp bone prosthesis
4	MeSH descriptor prostheses and implants explode	prostheses and implants.mp	prostheses and implants.mp
5	#1 or #2 or #3 or #4	or/1-4	or/1-4
6	MeSH descriptor ilium explode	exp ilium	exp iliac bone
7	#5 AND #6	(iliac adj1 crest).mp.	(iliac adj1 crest).mp.
8		or/6-7	or/6-7
9		5 and 8	5 and 8
10		exp clinical trial	clinical trial
11		comparative study	exp comparative study
12		exp prospective studies	exp prospective studies
13		or/10-12	or/10-12
14		9 and 13	9 and 13
15		exp animals/ not humans.sh	exp animals/ not humans.sh
16		14 not 15	14 not 15

* adj1 = adjacent within 1 word; exp = explode search; mp = multiple posting (search term considered in the title, abstract, or subject heading); sh = subject heading.

Surgical Technique

Anterior Harvest. Yang et al.[33] harvested tricortical bone from the anterior superior iliac spine, approximately 3.5–6 cm deep and 2.5–3 cm in thickness, by using an oscillating saw and osteotome. The control group received bone wax for hemostasis. The reconstruction group received selected autologous rib segments with the most appropriate contour, followed by bone wax. The reasons for harvest were anterior thoracic or lumbar fusion.

Resnick[25] harvested varying required amounts of tricortical bone 2–4 cm lateral to the anterior superior iliac

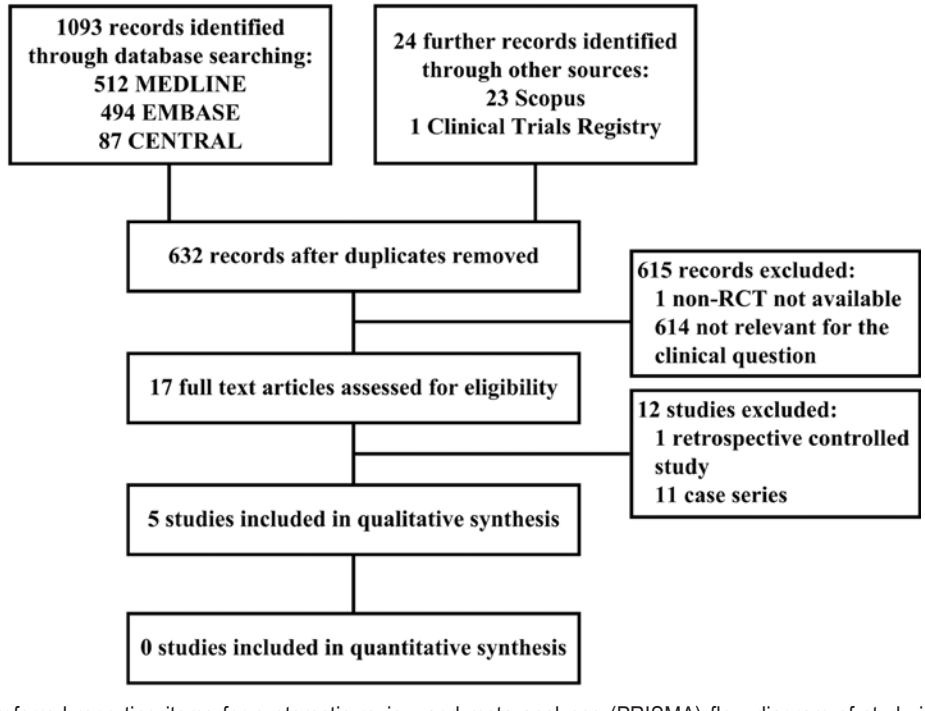

Fig. 1. Preferred reporting items for systematic review and meta-analyses (PRISMA) flow diagram of study identification, inclusion, and exclusion of human studies evaluating reconstruction of iliac crest defects following harvest for spinal fusion.

TABLE 3: Summary of included studies*

Authors & Year	Country	Study Design	Evidence Class	Intervention	Source
Yang et al., 2009	China	RCT	II	autograft rib	CENTRAL, MEDLINE, EMBASE
Bojescul et al., 2005	US	RCT	II	CHA†	CENTRAL, MEDLINE, EMBASE
Resnick, 2005	US	RCT	II	β-TCP	CENTRAL, MEDLINE, EMBASE
Bapat et al., 2008	India	NRCT	III-2	autograft rib	MEDLINE, EMBASE
Epstein & Hollingsworth, 2003	US	NRCT	III-2	mesh & ICM	CENTRAL, MEDLINE

* β-TCP = beta–tricalcium phosphate.
† Pro Osteon 500 in this study.

spine, 12–16 mm deep. Irrigation with antibiotics and saline followed by cautery for hemostasis was applied. The control group received Gelfoam hemostatic agent, whereas the investigative group received packed morcellized tricalcium phosphate. The reasons for harvest were 1- or 2-level anterior cervical discectomy and fusion, or 1-level cervical corpectomy.

Bapat et al.[4] harvested varying required amounts of tricortical bone 3 cm posterior to the anterior superior iliac spine. Sharp cortical edges were rounded off. Irrigation and hemostasis were applied. In the investigative group, 5-mm notches were prepared on either side of the defect. A section of rib with the most appropriate contour was then chosen, excised, and implanted into the iliac defect with impaction into the notches. The reasons for harvest varied between groups, and are outlined in Table 8.

Epstein and Hollingsworth[12] harvested an average of 3-cm-long strut grafts from the left anterior iliac crest by using an oscillating saw and curved osteotome (N. E. Epstein, personal communication, 2012). The first 23 patients had bone wax applied to the cancellous surface. The next 23 patients received iliac crest reconstruction in which a MacroPore polymer sheet (MacroPore, Inc.) and ICM (Sofamor Danek), a form of demineralized bone matrix with minute amounts of bone morphogenetic protein suspended in gel, were used. The ICM gel was warmed and applied into the iliac crest defect, followed by application of the contoured MacroPore sheet. Two resorbable screws were placed on either side of the cortical shelves. The reasons for harvest were for single-level anterior cervical corpectomy and fusion.

Posterior Harvest. Bojescul et al.[5] used the "trapdoor" technique for their posterior iliac crest harvest. A 2 × 4 × 2–cm cortical window was created 8 cm from the

TABLE 4: Characteristics of Yang study*

Characteristic	Data
methods	RCT; duration 1 yr
participants	mean age 42 yrs (range not stated) eligibility criteria: ant thoracic or lumbar surgery, w/ ant iliac crest harvest exclusion criteria: inappropriate ribs on preop x-ray, severe neurological deficit, preexisting hip pain or discomfort, mental illness total recruited: 54 pts (masking not stated); 39M:15F
intervention	autograft rib; 25 pts
comparison	no iliac crest reconstruction, hemostatic bone wax; 29 pts
outcomes	primary outcomes: 1) donor site pain measured using VAS when lying still on op side, & when active (2 wks, 3 mos postop); pain measured using VAS when sleeping on op side (1 yr) 2) pt satisfaction w/ cosmesis (unsatisfied, moderately satisfied, satisfied) (1 yr) 3) pt comfort when wearing a belt w/ activity (uncomfortable, moderately comfortable, comfortable) (1 yr) 4) any clinical complications including fractures (w/in 1 yr) (masking not stated)
loss to FU	none
funding/COI	no declaration

* Ant = anterior; COI = conflict of interest; FU = follow-up; pts = patients.

TABLE 5: Characteristics of Resnick study

Characteristic	Data
methods	single-blinded RCT; duration 3 mos
participants	mean age 45 yrs (range not stated) smokers (29 of 30) eligibility criteria: 1- or 2-level ant cervical discectomy & fusion, or 1-level cervical corpectomy, w/ ant iliac crest harvest exclusion criteria: not stated total recruited: 30 pts (blinded); 19M:11F
intervention	morcellized β-TCP; 15 pts
comparison	no iliac crest reconstruction, Gelfoam hemostatic agent; 15 pts
outcomes	primary outcomes: pain (immediately preop, & 24 hrs, 6 wks, & 3 mos postop) measured w/ patient-reported McGill pain questionnaire (acute pain) & VAS (generalized pain) secondary outcomes: plain x-ray appearance, cosmesis as determined by surgeon (not blinded)
loss to FU	none
funding/COI	supported by Orthovita, Inc. (Malvern, PA; manufacturer of the intervention)

TABLE 6: Characteristics of Bojescul study

Character-istic	Data
methods	double-blinded RCT; duration 1 yr
participants	mean age 35 yrs (range 23–67 yrs) eligibility criteria: spinal fusion, w/ posterior iliac crest harvest exclusion criteria: pregnancy, peripheral vascular disease, localized or systemic disease total recruited: 12 pts (blinded); 10M:2F
intervention	CHA; 5 pts
comparison	no iliac crest reconstruction; 7 pts
outcome	primary outcomes: donor site pain (predischarge, & at 6 wks, 3 mos, 6 mos, & 1 yr postop) measured w/ questionnaire (0, none; 1, mild; 2, medium; 3, moderate; 4, severe) and clinical palpation secondary outcomes: plain x-ray, CT, & SPECT appearance, determined by 2 blinded observers
loss to FU	1 pt from each group
funding/COI	none

TABLE 8: Characteristics of Bapat study

Characteristic	Data
methods	NRCT; duration 1 yr allocation according to surgical approach
participants	mean age 39 yrs (range not stated) eligibility criteria: spinal fusion of ant column, w/ ant iliac crest harvest exclusion criteria: iliac defects <25 mm, incomplete neurological recovery, persistent sensory abnormalities total recruited: 36 pts (masking not stated); 10M:26F
intervention	autogenous rib graft; 20 pts (thoracotomy [16] or thoracophrenicolumbotomy [6])
comparison	no iliac crest reconstruction; 16 pts (ant cervical corpectomy [2], ant column reconstruction retroperitoneally [2], thoracotomy [11], or thoracophrenicolumbotomy [3])
outcome	primary outcomes: donor site pain (at 6-wk, 3-mo, 6-mo, & 12-mo FU) measured w/ questionnaire & localized tenderness secondary outcomes: functional disability during routine activities or sleeping on op side, cosmesis, plain x-ray appearance, clinical complications (all determined blinded)
loss to FU	2 pts from each group
funding/COI	none

posterior superior iliac spine, and cancellous bone was harvested. Patients in the investigative group received sterile blocks and granulated CHA (Pro Osteon Implant 500). The reason for harvest was for spinal fusion (no further details given).

Primary Outcome: Donor Site Pain

All studies examined donor site pain as a primary outcome. Yang et al.[33] reported decreased donor site pain at 2 weeks and 3 months in patients with reconstruction compared with those without reconstruction when active ($p < 0.05$), but not when at rest ($p > 0.05$). At 1 year, patients with reconstruction experienced less pain when sleeping on the operative side ($p < 0.05$).

Resnick[25] observed that the pain scores of patients with reconstruction were significantly lower than those in the control group in terms of both number and severity at the 6-week mark ($p < 0.001$). However, by 3 months, as the pain scores of the group without reconstruction diminished, a significant difference could no longer be detected. The trend was only significant for the results of the McGill pain questionnaire, but not the VAS.

Bojescul et al.[5] reported the donor site pain results at 1 year only, although they had also assessed pain at earlier time points (1 patient in each group was lost to follow-up). Three of 4 patients who underwent reconstruction reported no pain, and 1 reported mild pain. Of the 6 patients without reconstruction, 2 subjectively had

TABLE 7: Assessment of potential bias in included RCTs*

Criteria	Yang et al.	Resnick	Bojescul et al.
random sequence generation (selection bias)	+	?	?
allocation concealment (selection bias)	?	?	?
blinding of participants (performance bias)	?	+	+
blinding of personnel (performance bias)	?	–	+
blinding of outcome assessment (detection bias)	?	+	+
incomplete outcome data (attrition bias)	+	+	–
selective reporting (reporting bias)	+	+	–
other potential sources of bias	4 cases of Pott disease in rib group	almost all smokers	age difference, very small nos.
summary assessment of risk of bias	moderate	moderate	high

* Using criteria as set out by Higgins and Green in the Cochrane Handbook. + = low risk of bias; – = high risk of bias; ? = unclear, method not stated.

TABLE 9: Characteristics of Epstein study

Characteristic	Data
methods	NRCT; duration 2–3 yrs allocation: first 23 pts no reconstruction, second 23 pts reconstruction
participants	mean age 44 yrs (range 23–67 yrs) eligibility criteria: 1-level ant cervical corpectomy & fusion, w/ iliac crest harvest exclusion criteria: not stated total recruited: 46 pts (masking not stated); 28M:18F
intervention	MacroPore sheet & ICM; 23 pts
comparison	no iliac crest reconstruction, bone wax hemostatic agent; 23 pts
outcome	primary outcomes: bodily pain (1 wk preop, & 6 wks, 3 mos, 6 mos, & 12 mos postop) measured using SF-36 secondary outcomes: CT appearance (masking not stated)
loss to FU	none
funding/COI	no declaration

TABLE 10: Methodological assessment of included NRCTs*

Criteria (max score)	Bapat et al.	Epstein & Hollingsworth
reporting (10)	9	8
external validity (3)	2	1
internal validity–bias (7)	6	4
internal validity–confounding (6)	1	1
power (1)	0	0
total (27)	18	14

* According to the validated checklist developed by Downs and Black.

no pain, 1 had mild pain, in 2 it was medium, and in 1 moderate. Objective pain analysis yielded similar results, and did not reveal any statistical significance ($p = 0.199$).

Bapat et al.[4] reported that 15% of patients with versus 69% of those without reconstruction had donor site pain at the 1-year follow-up ($p = 0.001$), with patients who had undergone reconstruction also experiencing significantly lower intensity of pain ($p < 0.001$). Tenderness on palpation was elicited in a similar percentage of patients ($p = 0.003$).

Epstein and Hollingsworth[12] commented that postoperative pain measured through SF-36 bodily pain scores revealed comparable results over the course of 12 months, with a trend toward greater improvement in the group without reconstruction. However, no statistical analysis was performed.

Secondary Outcomes

Quality of Life and Functional Disability. Yang et al.[33] examined comfort when wearing a belt with activity at 1 year, asking patients to categorize according to uncomfortable, moderately comfortable, and comfortable. More patients who underwent reconstruction reported being comfortable, and more patients without reconstruction reported being uncomfortable ($p < 0.05$).

Bojescul et al.[5] reported that no patients from either group had functional impairment from donor site pain at 1-year follow-up. Bapat et al.[4] found that patients without reconstruction experienced donor site pain causing discomfort while sleeping on the operative side (31%), discomfort wearing trousers (18%), and a persistent limp (6%) at 1 year. No patients in the group with reconstruction reported these functional disabilities.

Epstein and Hollingsworth[12] provided data on a range of health and function parameters as measured through SF-36 data. Outcomes appeared similar; however, no statistical analyses were performed.

Cosmesis. Yang et al.[33] asked patients to categorize their level of satisfaction with donor site cosmesis at 1 year as unsatisfied, moderately satisfied, or satisfied. All 25 patients who underwent reconstruction reported being moderately satisfied or satisfied, whereas 12 of the 29 patients without reconstruction reported being unsatisfied (no statistical analysis). The authors noted that a number of patients in the nonreconstructed but not in the reconstructed group exhibited clear surface indentation at the harvest site.

Resnick[25] determined that there was no significant difference in unblinded surgeon–determined cosmesis at 3 months. Bapat et al.[4] reported significantly poorer cosmetic VAS scores for their nonreconstructed group as determined by a blinded observer ($p = 0.009$), with a significantly higher number of Grades 2 and 3 iliac crest defects ($p < 0.001$).

Radiological Analysis. Yang et al.[33] found no graft displacement on x-ray studies obtained at 1 year for their rib-reconstructed group. Resnick[25] reported that x-ray evaluation of graft defects was not a useful method of assessment.

Bojescul et al.[5] found that 3 of 4 patients who underwent CHA reconstruction (1 was lost to follow-up) had evidence of bony ingrowth on x-ray and CT studies at 1 year. All had biological activity on bone scans. This compared with 1 of 6 patients without reconstruction who had bony ingrowth on x-ray and CT studies ($p = 0.190$), and no patients with biological activity on bone scans ($p = 0.0048$).

Bapat et al.[4] reported that 19 of 20 rib grafts achieved fusion at 6 months, evaluated primarily by x-ray studies. One patient experienced graft resorption, and another experienced graft displacement, whereas a third patient suffered an iliac crest fracture intraoperatively during graft impaction, and was reassigned to the nonintervention group.

Epstein and Hollingsworth[12] reported 100% fusion at 6 months in their reconstructed group as determined on CT studies. Ectopic bone formation was observed to be severe in 9%, moderate in 35%, and mild in 56% of cases, but did not adversely affect outcome.

Resource Use. Only Epstein and Hollingsworth[12] reported results for this outcome, despite it not being mentioned in the protocol. Hospital stay for the reconstructed group was 3.6 days, compared with 3.2 days for the non-

reconstructed group, leading the authors to conclude that no difference existed (no statistical analysis). The baseline operating time of 3 hours was increased by a mean of 24 minutes in the reconstructed group.

Postoperative Complications. Yang et al.[33] reported no complications for both groups. Resnick[25] reported on 1 patient from the nonreconstructed group who experienced a graft site infection requiring suture removal and oral antibiotics. Bojescul et al.[5] reported 1 superficial infection of the harvest site in the reconstructed group, which did not involve the implant. Bapat et al.[4] reported 5 complications (31%) in 16 cases without reconstruction. The complications were skin tenting and pressure necrosis, bursitis, scar hypertrophy, infection, and persistent limp. There were no complications in the reconstructed group.

Discussion

Summary of Evidence

As far as we are aware, this review is the first attempt to evaluate systematically the evidence for reconstruction following iliac crest harvesting for spinal procedures. Currently, there is insufficient high-quality evidence to determine definitively the clinical utility of donor site reconstruction following harvest for spinal procedures. However, the best available data identified through this systematic review suggest that iliac crest reconstruction may be useful in reducing postoperative pain, minimizing functional disability, and improving cosmesis. No pattern of other clinical, radiological, or resource outcomes was identified.

Limitations of This Review

The strength of any review relies on the quality of the studies it examines. In this systematic review we identified 5 studies comparing reconstructive against no reconstructive intervention for iatrogenic iliac crest defects. Three studies were RCTs (totaling 96 patients) and 2 were NRCTs (totaling 82 patients). All examined iliac crest harvesting in the context of spinal fusion procedures.

Critical evaluation of the included studies revealed a moderate to high risk of bias, especially in the NRCTs, which were particularly prone to poor internal validity, with a high risk of selection bias and confounding. Although we decided to include these latter studies due to the anticipated small number of RCTs, the specific limitations of these NRCTs should be borne in mind when evaluating their results.

Additional limitations include heterogeneity between studies, such as patient population, level of spine operated on (and hence size of defect), site of iliac crest grafting (anterior vs posterior harvesting), harvesting technique, reconstruction technique and type of graft used, method of outcome evaluation, and the small number of patients involved. As a result, specific questions such as harvesting or reconstruction technique could not be evaluated.

Although we broadened our search strategy by not applying any language restrictions, performing extensive cross-referencing of relevant studies, and a search for recently completed or ongoing trials, our review is susceptible to publication bias because we did not include an extensive search for so-called gray literature. Studies that did not show an effect for reconstruction would be most likely to remain unpublished.

Conclusions

The evidence supporting reconstruction following iliac crest harvest for spinal fusion is poor. However, the best available evidence identified in this systematic review supports the notion that iliac crest reconstruction following harvest for spinal fusion may reduce postoperative pain, minimize functional disability, and improve cosmesis. The optimal type of graft material or surgical technique was not investigated, and remains a relevant question for future clinical studies.

Disclosure

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